



IRT CAPACITY STUDY

1 2 3 4 5 6 S LINES



Prepared for:



New York City Transit

by:
STV

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A - EXECUTIVE SUMMARY



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EXECUTIVE SUMMARY

A.0 Revision History

Revision No.	Date	Description of Revision
0	June 23, 2020	Initial Draft Release
1	July 31, 2020	Final Release

EXECUTIVE SUMMARY

A.1 Introduction

The MTA and NYCT retained the STV Team to perform a line capacity simulation and improvement study for the 1 2 3 4 5 6 and S Lines. This work supports NYCT's evaluation of capacity constraints and improvements on these A-Division lines in both the near-term and long-term, under both current and future operating conditions. It also supports the ongoing Utica Avenue Corridor Study.

The project delivers a detailed rail simulation model of these lines, a tool that aided in the analysis of bottlenecks, including but not limited to, track, signal interlocking, and station constraints. The study has identified potential improvements and provided recommendations for capital improvements developed at a conceptual level and/or operating strategies to alleviate these constraints. Order-of-magnitude cost estimates are included in Part H of this report.

Prior to the COVID-19 pandemic, NYCT faced large increases in ridership in recent years as the economy of New York City and the metropolitan region expanded. Several A-Division lines were already stressed serving ridership demand, with riders experiencing overcrowded conditions and the network struggling with reliability as a result. As of the date of this report it is impossible to predict future ridership, but the subway system clearly will remain challenged to deliver quality service to current and future riders. These challenges may be exacerbated if long-term COVID-19-impacts include an increase in minimum space per passenger in future NYCT service standards.

The ability to add service to meet growing demand over the 30-year planning horizon of the project is constrained by multiple factors that have not previously been fully quantified. Addressing these constraints requires corridor-specific plans that consider multiple limitations related to fleet, station, interlocking, track, and terminal capacity, among others. Although some potential capacity improvements have been identified previously, this study is the first comprehensive analysis of A-Division network capacity, including existing constraints and the travel time, capacity and reliability benefits of a broad range of capital improvements.

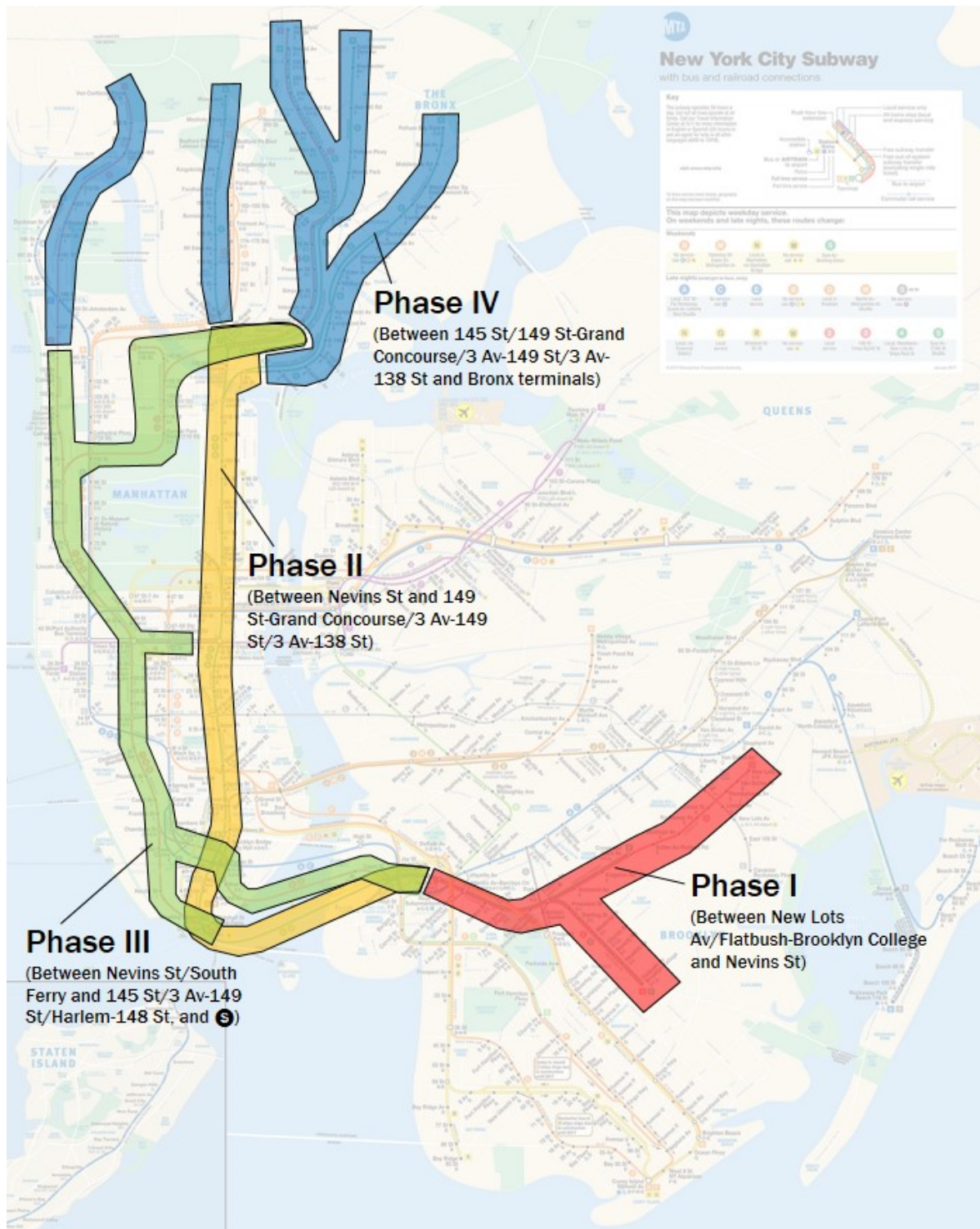
NYCT has chosen the A-Division 1 2 3 4 5 6 and S Lines as the initial study area. Based on the current service design, the 2 3 4 and 5 Lines are operating at maximum capacity, with riders experiencing overcrowded conditions prior to the COVID-19 pandemic. Strong population growth in the Bronx and Upper Manhattan, as well as the opening of the MTA LIRR East Side Access Project, likely will necessitate significantly more service on the Manhattan trunk lines along Lexington Avenue (4 5 6 Lines) and 7th Avenue/Broadway (1 2 3 Lines). In order to accommodate more riders on these lines, track, signal, interlocking, terminal, and station constraints throughout the A-Division must be addressed.

A.1.1 Study Area and Phases

The original intention for this study was to advance in the following four sequential phases, as shown in Figure A.1-1:

- **Phase I:** 2 3 4 and 5 Lines between Nevins Street (all four tracks) and the terminals at Crown Heights-Utica Avenue 4, New Lots Avenue 3, and Flatbush Avenue-Brooklyn College 2 5.
- **Phase II:** 4 5 6 Lines between Nevins Street (express tracks 2 and 3 only) and 149 Street-Grand Concourse 4 / 3 Avenue-149 Street 5 / 3 Avenue-138 Street 6.

Figure A.1-1. Study Area and Phases



- Phase III:**
 - 1** Line between South Ferry and 145 Street, the
 2 Line between Nevins Street (local tracks 1 and 4) and 3 Avenue-149 Street, the
 3 Line between Nevins Street (local tracks 1 and 4) and the Harlem-148 Street terminal, and the
 S Line between Grand Central-42 Street and Times Square-42 Street based on the planned two-track alignment.

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- **Phase IV:** ① Line between 145 Street and the Van Cortlandt Park-242 Street terminal, the ② and ⑤ Lines between 3 Avenue-149 Street and the terminals at Nereid Avenue ⑤, Wakefield-241 Street ②, and Eastchester-Dyre Avenue ⑤, the ④ Line between 149 Street-Grand Concourse and the terminal at Woodlawn, and the ⑥ Line between 3 Avenue-138 Street and the terminals at Parkchester and Pelham Bay Park.

To save time, the study was performed in just two sections. Phases I and II were first completed together before being incorporated into the full network (Phases I through IV) analysis. The results of Phase I helped inform the priority Brooklyn A-Division capital improvements being investigated by the Utica Av Corridor Study. Phase IV includes the simulation of specific shortlisted concept designs in Brooklyn developed by the Utica Avenue Corridor Study Team in response to the Phase I input.

The scope of the task included proposing and developing a rail network operations simulation software database, as follows:

1. Routes modeled include the entirety of the ① ② ③ ④ ⑤ ⑥ and ⑧ Lines in four sequential phases, as described in Figure A.1-1. Some of these routes might not correspond to current service plans. NYCT provided precise routings to the consultant prior to the commencement of Phase I.
2. Incorporate the base, existing service plans on these lines with additional train frequencies added through existing infrastructure to determine capacity of each line.
3. Incorporate dwell times in the simulations, as provided by NYCT Operations Planning. The dwell times vary by station, operating period, service, and direction of travel.
4. Incorporate into the simulation common operating rules and practices that are not necessarily enforced by the signal system, including:
 - a. Berthing at Platforms – Under wayside signaling, no train will be permitted to enter a station unless it can berth fully in the proper location along the platform for the train's length. This is to prevent any train from stopping part way into a station and to prevent passengers from attempting to board or disembark from a partially berthed train.
 - b. Departing Platforms – No train will be permitted to depart a station platform unless it can pull all the way out. This is to prevent any trains from stopping part way out of a station and to prevent passengers from attempting to board or disembark from a partially berthed train.
 - c. Door Operations at Stations – If the leaving signal at a station platform is red, a train's doors shall remain open until the signal clears, even if that is longer than the specified dwell time in the model. Once the signal clears, it is assumed that it takes approximately 20 seconds for the train to start moving, because of Train Operator reaction time, communication time between the Train Operator and Conductor, and the time it takes the Conductor to close the doors.
 - d. Operation through Interlockings – No train will be permitted to enter an interlocking that is not cleared unless the train can clear the entire interlocking.

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- e. Operating plans. Perform simulations under current operating plans and proposed service plan scenarios. For future scenarios some working route designations change and new routes are added. Simulations will be appropriately randomized in consultation with NYCT Operations Planning.
5. Bottlenecks and recommendations. For Phase I, identify bottlenecks after running increased base service, including, but not limited to potential track, signal, and interlocking improvements that can alleviate these bottlenecks. Major capital investments within the Phase I study area will developed as part of a separate study of a potential Utica Avenue Line and not part of this study. For Phases II - IV, identify bottlenecks (including but not limited to, track, signal, and interlocking), potential signal or other conceptual capital improvements and/or operating strategies to alleviate these bottlenecks.
6. Where appropriate, prepare conceptual engineering drawings of proposed modifications.
7. Develop order-of-magnitude cost estimates.
8. Identify the type and magnitude of any temporary subway service impact needed to install proposed modifications.
9. Signals. Incorporate the following into the database:
 - a. The existing wayside fixed-block signal system on the Lexington Avenue Line (between 149 Street-Grand Concourse / Jackson Avenue / 3 Avenue-138 Street and Nevins Street;
 - b. As part of Phase II, incorporate a conceptual CBTC system for the 4, 5, and 6 Lines between 149 Street-Grand Concourse / Jackson Avenue / 3 Avenue-138 Street and Nevins Street, based on the current NYCT CBTC design standards established for the Queens Boulevard Line or as directed by NYCT;
 - c. The layouts under contract along the Dyre Avenue Line (between East 180 Street and Eastchester-Dyre Avenue) for conventional wayside fixed-block signals (currently under signal system modernization) and for the 42 Street Shuttle between Grand Central and Times Square (planned to be converted to a two-track line accommodating six-car trains); and
 - d. The existing wayside fixed-block signal system at all other locations.
10. Interlockings. Incorporate the following interlockings, which will be used in the scenarios to be simulated, into the database. Assume all interlockings operate on a “first come, first served” basis:

Table A.1-1– A-Division Interlockings

Line	Interlocking	Line Designation and Chain
Broadway	72 Street	B-272
	96 Street	B-343
	103 Street	BB-13
	137 Street	BB-110
	168 Street	BB-191
	Dyckman Street	BB-274

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Table A.1-1– A-Division Interlockings

Line	Interlocking	Line Designation and Chain
Broadway	211 Street	BB-306
	215 Street	BB-318
	240 Street	BB-395
7 Avenue	Times Square	V-12
	14 Street	V-79
	Chambers Street	V-165
	South Ferry	VA-219
Lenox Avenue	110 Street	F-65
	142 Street	F-147
	Lenox Avenue Yard	F-169
	149 Street	F-180
	Jackson Avenue	F-238
Jerome Avenue	138 Street	J-272
	149 Street	J-292
	167 Street	J-361
	Burnside	J-438
	Kingsbridge	J-501
	Jerome Yard	J-535
	Woodlawn	J-573
White Plains Rd	East 180 Street South	W-383
	East 180 Street	W-390
	East 180 Street Yard	W-395
	Bronx Park East	W-408
	219 Street	W-546
	239 Street	W-613
	Unionport Yard	W-UP
	239 Street Yard	W-632
	239 Street High Yard	W-620
Dyre Avenue	Morris Park	Y-175
	Dyre Avenue	Y-331
Pelham	3 Avenue	P-281
	Hunts Point Avenue	P-413
	East 177 Street	P-526
	Westchester Square	P-589
	Pelham Bay Park	P-635
	Westchester Avenue Yard	PY-591
Lexington Avenue	Grand Central	L-9
	59 Street	L-59
	86 Street	L-134
Lexington Avenue	125 Street	L-230
	Bowling Green	M-31
	Brooklyn Bridge	MM-10
	14 Street	MM-98
Clark Street	Wall Street	K-208
Eastern Parkway	Borough Hall	E-114
	Nevins Street	E-148
	Brooklyn Museum	E-223
	Nostrand Avenue	E-255
	Utica Avenue	E-320
	Junius Street	E-414
	New Lots	E-446

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Table A.1-1– A-Division Interlockings

Line	Interlocking	Line Designation and Chain
Eastern Parkway	Livonia Yard	E-475
Nostrand Avenue	President Street	D-272
	Church Avenue	D-334
	Flatbush Avenue	D-393

A.1.2 Deliverables

1. Prepare simulation reports for each of the operating scenarios and a report assessing bottlenecks identified in the simulations.
2. Develop time-distance string charts for all simulations.
3. Prepare output statistics on throughput, running times, and signal delay for each simulation. Identify signals likely to constrain throughput in practice.
4. Provide a narrative recommending professional opinion as to whether the simulation scenario represents reliable operations under “real world” conditions.
5. Prepare each draft report of the operations simulations and submit in electronic format to NYCT for review and comment.
6. Present results of each scenario to NYCT staff as the simulations are completed. The presentations should include animations of the results. The presentations should be scheduled as results become available, before submittal of draft reports.
7. Prepare a summary of the identified bottlenecks and proposed improvements or modifications recommended to alleviate them. Include in the report with supporting back-up information in an appendix:
 - a. Conceptual engineering drawings of proposed modifications;
 - b. Summary order-of-magnitude cost estimates; and
 - c. Subway service impacts.

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A.2 Future Baseline CBTC Operating Plan

As stated above, part of the scope of this study concerns the implementation of CBTC on the A-Division. This study addresses all A-Division Lines except for the 7 Flushing Line with a focus on Lexington Avenue Line capacity improvements. Specifically:

1. Incorporate a conceptual CBTC system for the 4, 5, and 6 Lines between 149 Street-Grand Concourse/Jackson Avenue/3 Avenue-138 Street and Nevins Street, based on the current NYCT CBTC design standards established for the Queens Boulevard Line or as otherwise directed by NYCT; and
2. Examine existing capacity constraints across the 1 2 3 4 5 6 and S Lines in terms of the existing signal system and these locations' capacity to handle increased throughput with CBTC.

To provide the greatest service build-up and ramp-down stress on the network, the future baseline CBTC operating plan utilizes existing off-peak train volumes and higher peak train volumes. Peak train volumes for the 0700 - 0900 and 1630 - 1830 time periods are assumed to be:

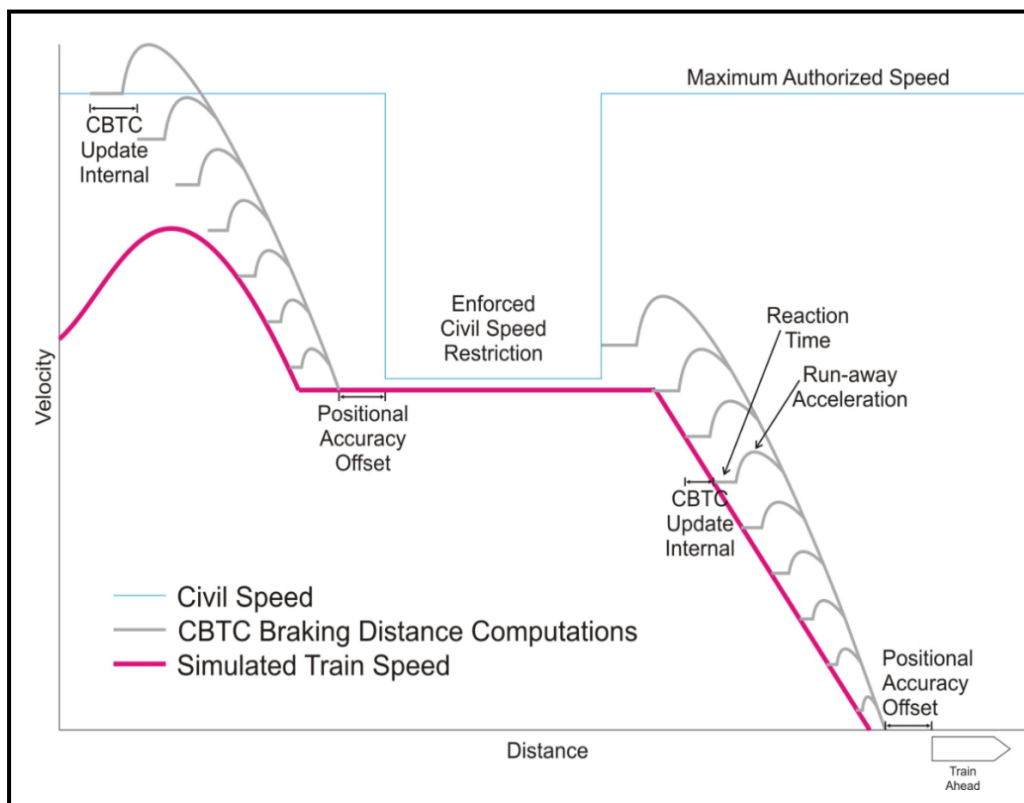
- 1 Line: 30 Trains per Hour (TPH)
- 2 Line: 13 TPH
- 3 Line: 13 TPH
- 4 Line: 21 TPH
- 5 Line: 9 TPH
- 6 Line: 30 TPH

A.2.1 Key CBTC Assumptions for Modeling

1. CBTC Safe Braking Distance model with 1.8 miles per hour per second (MPHPS) brake rate.
2. Slack Protection functionality:
 - a. End of track locations (applies to all trains).
 - b. Interlockings at or close to station platform limits (applies only to trains approaching interlocking signal at stop).
3. Station following train logic:
 - a. Under extremely rare circumstances, can result in one or two trains partially platformed.
 - b. Automated Train Operation (ATO) prevents accidental door opening by the Conductor when the train is not fully platformed.

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Figure A.2-1 - Proposed NYCT A-Division CBTC System Functionality



Typical simulation CBTC train performance (magenta line) with civil speed profile (blue line) and typical internally generated CBTC braking curves (gray curves).

A.2.2 Proposed CBTC Vehicle Performance for Computation of Movement Authorities

Table A.2-1. NYCT CBTC Simulation Parameters

Item #	Parameter	NYCT Value	Description
CBTC Vehicle Performance for Computation of Movement Authorities			
1	Overspeed detection time (runaway acceleration)	2.0 sec	Runaway acceleration based on high rate CBTC train performance. Also covers train that is underspeed and accelerating.
2	Power removal time (runaway acceleration)	0.650 sec	Runaway acceleration based on high rate CBTC train performance.
3	Coast/brake build-up	2.0 sec	Jerk rate limit of 2mph/s/s between #2 and #4 causes total of coasting and brake build-up to be about 2 sec.
4	Guaranteed Emergency Brake Rate (GEBR)	-1.8 mph/s	NYCT is using -1.4 mph/s on Queens Boulevard Line CBTC but recent vehicle tests show support for a higher GEBR.
5	ATP overspeed allowance	1.5 mph	Allowance in the Safe Braking Distance model to prevent nuisance alarms/penalties when train is approaching maximum authorized speed.
6	Worst case speedometer error	2.0 mph	Allowance in the Safe Braking Distance model to accommodate a train that is actually moving faster than speedometer results.

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Table A.2-1. NYCT CBTC Simulation Parameters

Item #	Parameter	NYCT Value	Description
CBTC System Performance			
7	Buffer distance ahead of train	0 ft	Safety buffer separate from any accounting of Positional Uncertainty (see below). NYCT indicates this is already accounted for in braking model.
8	Buffer distance behind train	0 ft	Safety buffer separate from any accounting of Positional Uncertainty (see below). NYCT indicates this is already accounted for in braking model.
9	Maximum train to wayside communication time	500 ms x 2 cycles = 1.0 sec	For headway (following move) purposes, based on Thales "FLNY Timing Analysis – CBTC" document.
10	Wayside to train communication	500 ms x 2 cycles = 1.0 sec	For headway (following move) purposes, based on Thales "FLNY Timing Analysis – CBTC" document.
11	On-board computer update interval	350 ms x 2 cycles = 0.7 sec	For headway (following move) purposes, conservative (long) values based on suggestion by NYCT CBTC Team.
12	Maximum speed measurement error (mph)	1% (modeled in TrainOps® as Schedule Margin)	Will adjust vehicle speed down by 1% in network simulation (not in computation of CBTC safe braking distance minimum separation) for conservative trip time and capacity assessment. For example, 50 mph will be adjusted to 49.5 mph.
13	Maximum positional uncertainty	30 ft.	Applied separately to both front and back of train. NYCT value is based on assumed maximum 1000 ft separation between transponders with maximum possible 3% accumulated error. Applies to both train ahead (could be closer than computed) and train behind (could be closer than computed).
14	ATO station stop brake rate	2.1 mph/s	Higher than GEBR due to lack of need for vitality. NYCT has suggested 2.3 to 2.4 mph/s. However, a sample of 10 Car 8116 stops yielded 2.11 mph/s and a sample of 10 Car 8112 stops yielded 1.83 mph/s.
15	CBTC MAL targets within interlockings	Treat interlocking route as entirely occupied or entirely unoccupied unless intermediate signals installed	Intermediate signals allow subdivision of CBTC Movement Authority within interlocking but only signal-to-signal.
16	CBTC MAL updates after interlocking sectional route release		NYCT has indicated that it does not use sectional route release within interlockings.

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Table A.2-1. NYCT CBTC Simulation Parameters

Item #	Parameter	NYCT Value	Description
17	Station Movement Authorities prevent partial berthing	<ul style="list-style-type: none"> A train berthed in the station won't move until it has a MAL that will let it clear the station. "Usable Platform" Limits must be cleared. The distance from the berthing position to the end of the usable platform varies, but typically not more than 15 feet + train length + distance from the end of the departing train's MAL to the rear of a train ahead, say 70-100 feet. Once the train berthed in the station moves, absent any restriction such as a Home Signal at the exiting end that prevents a train from berthing, the following train can enter. On top of this, communication and reaction delays have to be added. 	Per NYCT MOW Engineering 10/30/2018
18	End of track approach speeds	With bumper at end of platform, platform limits enforced at 20 mph with last 113 ft enforced at 6 mph. Bumper enforced at 5 mph based on its structural design.	Slack Protection functionality, emulating Flushing Line
19	Station berthing with end-of-platform interlocking signal at stop	With interlocking home signal at end of platform at stop, platform limits enforced at 20 mph with last 113 ft enforced at 6 mph. Signal at stop enforced at 5 mph based on approximate distance from trip stop to converging route fouling point.	Slack Protection functionality, emulating Flushing Line

A.2.3 CBTC Speeds for Standard NYCT Turnouts

Table A.2-2. CBTC Speeds for Standard NYCT Turnouts

Turnout #	Radius (feet)	Passenger Comfort Speed (MPH)	
		Standard AREMA	Tangential
4	151	7.5	11
4.5	191	8	Not Applicable
5	235	9	13
6	339	11	16
7	461	13	18.5
8	603	15	21
9	763	17	24
10	942	19	26.5

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Table A.2-2. CBTC Speeds for Standard NYCT Turnouts

Turnout #	Radius (feet)	Passenger Comfort Speed (MPH)	
		Standard AREMA	Tangential
11	1,139	21	29
12	1,356	22.5	32

Source: NYCT

A.2.4 Results of CBTC Simulation

The modeling the STV Team performed showed moderate to significant improvement in train speed under CBTC simulation than wayside simulation or actual measured wayside results. Refer to Section G for the charts showing these results.

A.2.5 Existing Baseline (Wayside) Signal System versus Future CBTC Baseline

The STV Team's study and findings on train operations (not rolling stock characteristics) in the baseline model and the future CBTC baseline are indexed by station and by line as follows:

Table A.2-3. Index: Baseline (Wayside) Calibration and Future CBTC Model

Line(s)	From	To	Baseline (Wayside) Calibration	Future CBTC
1	South Ferry	18 Street	Table A.4-1	Table A.4-21
1	23 Street	86 Street	Table A.4-2	Table A.4-22
1	96 Street	181 Street	Table A.4-3	Table A.4-23
1	191 Street	Van Cortlandt Park-242 Street	Table A.4-4	Table A.4-24
2 3	Flatbush Avenue-Brooklyn College	President Street Pennsylvania Avenue	Table A.4-5	Table A.4-25
2 3	Franklin Avenue Junius Street	Grand Army Plaza	Table A.4-6	Table A.4-26
2 3	Bergen Street	Chambers Street	Table A.4-7	Table A.4-27
2 3	14 Street	Harlem-148 Street	Table A.4-8	Table A.4-28
2 5	149 Street-Grand Concourse	East 180 Street	Table A.4-9	Table A.4-29
2 5	Bronx Park East	Wakefield-241 Street	Table A.4-10	Table A.4-30
5	Morris Park	Eastchester-Dyre Avenue	Table A.4-11	Table A.4-31
4 5	Flatbush Avenue-Brooklyn College	President Street Pennsylvania Avenue	Table A.4-12	Table A.4-32
4 5	Franklin Avenue Junius Street	Grand Army Plaza	Table A.4-13	Table A.4-33
4 5	Bergen Street	Grand Central – 42 Street	Table A.4-14	Table A.4-34
4 5	59 Street	176 Street	Table A.4-15	Table A.4-35
4	Burnside Avenue	Woodlawn	Table A.4-16	Table A.4-36
6	Brooklyn Bridge-City Hall	Grand Central – 42 Street	Table A.4-17	Table A.4-37
6	51 Street	125 Street	Table A.4-18	Table A.4-38
6	3 Avenue – 138 Street	Elder Avenue	Table A.4-19	Table A.4-39
6	Morrison Avenue – Soundview	Pelham Bay Park	Table A.4-20	Table A.4-40

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A.3 Focus Areas for Study of Capital Investments

The STV Team has studied various capital improvements that would improve subway operations, especially when CBTC is implemented on the A-Division lines. The focus of these improvements is on the present or potential capacity constraints or “choke points” on **1** **2** **3** **4** **5** **6** and **S** Lines noted in Table A.3-1 below:

Table A.3-1. Focus Areas for Study of Capital Investments

Location	Line(s)	Study Phase	Location Studied	Focus Area for Study	Proposed Resolution
New Lots Avenue	3 4	I	Yes	Yes	CBTC Implementation
Crown Heights–Utica Avenue	3 4	I	Yes	Yes	Deferred to Utica Avenue Corridor Study
Flatbush Avenue–Brooklyn College	2 5	I	Yes	Yes	Deferred to Utica Avenue Corridor Study
Nostrand Junction	2 3 4 5	I	Yes	No	Deferred to Utica Avenue Corridor Study
Brooklyn Bridge–City Hall	4 5 6	II	Yes	Yes	CBTC Implementation
14 Street–Union Square	4 5 6	II	Yes	Yes	Replace Existing Gap Fillers; CBTC Implementation
Grand Central–42 Street	4 5 6	II	Yes	Yes	Capital Investment; CBTC Implementation
125 Street	4 5 6	II	Yes	Yes	Operational Improvements at 125 Street, 3 Avenue – 138 Street, 149 Street – Grand Concourse
142 Street Junction	2 3	III	Yes	Yes	Operational Improvements
145 Street / Harlem–148 Street / Lenox Yard	3	III	Yes	Yes	Capital Investment
240 Street Yard / Van Cortlandt Park–242 Street	1	IV	Yes	Yes	Operational Improvement
Woodlawn	4	IV	Yes	No	None
East 180 Street	2 5	IV	Yes	Yes	Operational Improvement
239 Street Yard / Wakefield–241 Street	2 5	IV	Yes	Yes	Operational Improvement
Parkchester	6	IV	Yes	Yes	Capital Investment
Pelham Bay Park	6	IV	Yes	Yes	None

A.3.1 Phase I – Brooklyn Terminals

Improvements of the **Flatbush Avenue–Brooklyn College** terminal were evaluated and are discussed starting on Page D-3. Operational improvements at **Nostrand Junction** [Page D-10], **Crown Heights–Utica Avenue** [Page D-7], and **New Lots Avenue** [Page D-9] are also discussed, but no capital improvements other than CBTC are discussed, in part as these may be considered in the context of the ongoing Utica Avenue Corridor Study. Refer to the summary of the “Super Model” in paragraph A3.6.

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A.3.2 Phase II - Manhattan East Side

Improvements were considered at the following key locations: Brooklyn Bridge–City Hall, 14 Street–Union Square, Grand Central–42 Street, and 125 Street.

1. At **Brooklyn Bridge–City Hall** [Page D-22], the STV Team evaluated eliminating the turnout at the City Hall Loop that permits a southbound train to go to a tail track south of the station. This was dropped from further consideration as it would have eliminated a valuable tail track that is planned for reconnection to the main line just north of Fulton Street as part of the Lexington Avenue Line CBTC Project.
2. At **14 Street–Union Square** [Page D-23] a station reconfiguration was considered that would have moved the southbound platform farther north for the purpose of eliminating the existing platform gap fillers. This was dropped from further consideration owing to high cost and the findings that Grand Central-42 Street is a more capacity-constraining location under future CBTC operation.
3. **Grand Central–42 Street** [Page D-26] was identified as the greatest capacity constraint on the Lexington Avenue line. The STV Team studied in detail track and signal improvements both north and south of the station. South of the station, the improvements that were studied were dropped from further consideration as the probable high cost and operational impacts during construction would not justify the operational benefits. North of the station, the STV Team studied reconfiguring the existing interlocking into a split interlocking. The study revealed that this improvement would have a significant benefit for capacity and could be accomplished with work on nights and weekends. *This improvement is proposed for further development and implementation.*
4. At **125 Street** [Page D-34], the track configuration and speed limits north of the station limit capacity. Some improvement could be realized by safely increasing certain speed limits, but significant improvements will come only with operational improvements at 3 Avenue – 138 Street on the 6 Line, and at 149 Street – Grand Concourse on the 4 Line and 5 Line.

A.3.3 Phase III – Manhattan West Side

The most capacity constraining location in Phase III is the Lenox Avenue 3 Line, where reverse moves occur between Lenox Yard and Harlem-148 Street station and at the 142 Street Junction. Improvements were considered at 142 Street Junction, a flat (not grade-separated) junction of the 2 Line and 3 Line, and 145 Street station on the 3 Line.

1. At **142 Street Junction** [Page D-43], the STV Team investigated creating a grade-separated junction by putting the northbound 3 Line on a duck-under track. This was dropped from further consideration as the grade approaching 145 Street station would have been unacceptably steep, and the construction impacts on Malcolm X Boulevard (Lenox Avenue) would have been considerable.
2. The STV Team studied expansion of the **145 Street station** [Page D-43] in the context of facilitating moves to and from Lenox Yard. The configuration of tracks on the main line and in the yard does not permit an easy egress of trains from the terminal station, Harlem–148 Street, to Lenox Yard. The STV Team proposes that trains going to and from Lenox Yard terminate and originate at 145 Street station. To facilitate this, at least the northbound platform, and preferably both platforms, would have to be lengthened to allow

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all doors on a 10-car train to open, in the interest of customer safety and convenience and facilitating moves to and from Lenox Yard. *The STV Team recommends this improvement despite the probable high cost. Operations would benefit from easier moves to and from Lenox Yard.*

A.3.4 Phase IV – Bronx Terminals

Improvements were considered at the following locations: **240 Street Yard / Van Cortlandt Park–242 Street station** [starting on Page D-45], **East 180 Street station** [starting on [Page D-54], **239 Street Yard / Nereid Avenue Station / Wakefield–241 Street station** [starting on Page D-56], **Parkchester station** [starting on Page D-65], and **Pelham Bay Park station** [Page D-70].

1. The existing lead to 240 Street Yard goes north from the 238 Street station. Trains going to the yard from the terminal at Van Cortlandt Park–242 Street station must back onto the middle track in 238 Street station and then proceed to the yard.
 - a. The STV Team considered a new yard lead from just south of Van Cortlandt Park–242 Street station. This would require property takings and the curvature of the new yard lead would introduce additional noise to the community. While the STV Team explored this in detail, it is dropped from further consideration.
 - b. The STV Team also considered an alternative of reconfiguring a station south of Van Cortlandt Park–242 Street by constructing a northbound island platform at 225 Street station to allow yard-bound trains to terminate there and discharge passengers before proceeding. The first two stations south of Van Cortlandt Park–242 Street, 238 Street and 231 Street, do not have enough clearance between the station and the street to permit construction of a mezzanine required for an island platform. The next station south, 225 Street, has enough clearance at its north end for a mezzanine. While the STV Team explored this alternative in detail, it was dropped from further consideration because of the probable high cost and the likelihood of community opposition to expanding the elevated structure.
 - c. Neither alternative was found to increase capacity significantly under CBTC. In summary, no capital improvements are proposed at this location.
2. **East 180 Street station** [starting on Page D-54] is the junction of the 2 Line and 5 Line and is flanked by East 180 Street Yard to the west and Unionport Yard to the east. The configuration of the track junction north of the station introduces a potential conflict between southbound 2 Line and 5 Line trains. The STV Team explored upgrading yard track WB to mainline standard and routing southbound 2 Line trains approaching East 180 Street along that track to avoid the conflict. NYCT indicated they already operate peak hour southbound 2 Line trains along that track for that purpose. The potential off-peak conflict can be managed with schedule modifications that provide safe separation of 2 Line and 5 Line trains. Thus, no capital improvements are recommended here.
3. The existing lead to 239 Street Yard goes north from the Nereid Avenue station. Trains going to the yard from the terminal at Wakefield–241 Street station must back onto the middle track in Nereid Avenue station and then proceed to the yard.
 - a. The STV Team considered converting the existing yard junction to a wye by building a track from the yard lead northward toward Wakefield–241 Street station. This would require property takings and the tight curvature and significant grade

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of the new yard lead would introduce additional noise to the community. This alternative was dropped from further consideration.

- b. The STV Team also considered an alternative of reconfiguring Nereid Avenue station with a northbound island platform and a fourth mainline track to allow yard-bound trains to terminate there and discharge passengers before proceeding. This improvement would utilize the existing mezzanine and stairs from the platform to the mezzanine. While the STV Team explored this alternative in detail, it was dropped from further consideration because of the probable high cost and the likelihood of community opposition to expanding the elevated structure.
 - c. Neither alternative was found to increase capacity significantly under CBTC. In summary, no capital improvements are proposed at this location.
4. **Parkchester station** is the end point for all peak-hour and some off-peak 6 local trains. Other trains continue to, or originate from, Pelham Bay Park. The STV Team explored ways to mitigate conflicts between local trains originating there, local trains terminating there and either continuing to Westchester Yard or returning to Manhattan, and express trains, all constraining capacity. Changes to the existing interlocking north of the station were considered but adding a pair of parallel crossovers south of the station, and preserving the existing interlocking, appears to offer additional capacity and operational flexibility. This improvement could be accomplished with work on nights *and is proposed for further development and implementation.*
 5. **Pelham Bay Park station** is the terminal for most 6 Local trains and all 6 Express trains. The STV Team considered a possible capacity constraint arising from trains proceeding from the station to Westchester Yard. The junction of the mainline with the yard is a grade-separated wye accessible from the middle track and the southbound track. Thus, there appears to be no conflict at this location and no capital improvements are proposed at this location.

A.3.5 Implementation of CBTC

For budgetary and planning purposes, the cost (in 2015 economic conditions, based on the Queens Boulevard Line CBTC) to implement CBTC along 240 A-Division track miles would be \$974.4 million, or \$4.06 million per track mile, exclusive of vehicle-related costs, NYCT costs and “soft costs.”

The STV Team also reviewed the unit capital costs of two other “brownfield” installations: the completed Port Authority Trans Hudson (PATH) system-wide CBTC project and the recently awarded Bay Area Rapid Transit system-wide CBTC project. While the PATH costs included substantial vehicles-related work (not included in the A-Division costs) and therefore make direct comparisons difficult, the PATH per-track-mile costs after deducting estimated vehicles-related work are consistent with A-Division CBTC costs. The BART per-track-mile costs are consistent with A-Division CBTC costs.

A.3.6 The “Super Model”

Following the completion of CBTC Future Baseline network simulation analysis, a “Super Model” was developed which includes infrastructure improvements selected by NYCT to address previously identified capacity chokepoints. This is described in detail in Part E of this report. Improvements were modeled at the following locations:

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- New Lots Avenue
- Flatbush Avenue-Brooklyn College
- Crown Heights-Utica Avenue
- Grand Central-42 Street
- Parkchester

The “Super Model” was evaluated under both the Future Baseline CBTC operating plan as well as a Hybrid operating plan which straight-rails service through Nostrand Junction (replacing new Nostrand Junction crossover capability with analogs on the north side of Crown Heights-Utica Avenue instead) and introduces a new **8** Line service operating between Wakefield-241 Street and New Lots Avenue. The Future Baseline CBTC operating plan increases peak service delivery versus today’s service levels while the Hybrid operating plan adds still more service on the West Side Lines between the Bronx and Brooklyn.

“Super Model” results include end terminal on-time performance and peak service delivery (simulated versus scheduled). Apart from the infrastructure improvements and operating plan differences discussed in Part E of this report, all simulation inputs and parameters are identical to those in Part C of this report.

The STV Team developed the “Super Model” in coordination with the following:

- Existing Baseline and Future (CBTC) Baseline Network Simulation Results Technical Memoranda, Parts B and C of this report, respectively;
- A-Division Capital Improvements Analysis and Future (CBTC) Baseline Technical Memoranda, Parts D and C of this report, respectively;
- Utica Avenue Shuttle Single Train Simulations (Long and Short Interstation Spacing Variations); and
- Utica Avenue Express Tracks Connection Local Tracks Connection, each to be tested under Future Baseline, Service Reorientation, and Modified Hybrid Operating Plans.

A.3.6.1 Recommended Improvements in the “Super Model”

- Grand Central North Interlocking Improvements
- St. Lawrence Avenue/Parkchester New Crossovers
- Crown Heights-Utica Avenue Diamond Crossover Restoration (Utica Avenue Study)
- New Lots Avenue Interlocking Improvements (Utica Avenue Study)
- Flatbush Avenue-Brooklyn College Interlocking Improvements (Utica Avenue Study)

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A.3.6.2 *Improvements Not Recommended in the “Super Model”*

- 145 Street Station/148 Street - Lenox Yard Access Improvements
- Van Cortlandt Park-242 Street Terminal Yard Lead
- Marble Hill-225 Street Center Island Platform
- Nereid Avenue Center Island Platform/239 Street Yard Improvements
- Grand Central South Express Track Curve Modifications
- “Straight Railing” Brooklyn Bridge - City Hall Loop

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A.4 Page Index of Baseline (Wayside) Calibration and Future CBTC Baseline Simulations

The following tables contain page references for characteristics and results of the Baseline (Wayside) Calibration Simulation and Future CBTC Baseline by line and by station. Grayed out cells indicate that results were not generated for a particular metric. An asterisk (*) following the page number indicates that the page number shown is the first in a series addressing the stated metric.

Table A.4-1. Baseline (Wayside), 1 Line, South Ferry – 18 Street

	South Ferry	Rector Street	Cortlandt Street - WTC	Chambers Street	Franklin Street	Canal Street	Houston Street	Christopher Street	14 Street	18 Street
Simulated Travel Time	B-7									
Average Speeds: Peak Periods	B-8									
Simulated Terminal On-Time Performance & Comparison	B-9, B-24, B-26									
Dwell Time Inputs		F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*
Terminal Turn Times	F-26									
Routing	F-27									
Operating Variability										
Peak Service Delivery										
Minimum Supportable Headways	F-277*, F-282*									
Simulated Congestion Locations	B-23									
Station Time Signal Control Line Cutback Events	B-30									
Section F.2 - Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots	F-31									
Section F.3 - Time-Distance ("String") Charts				F-189*						
Section F.4 - Simulated Station Occupancy Charts	F-271*									

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Table A.4-2. Baseline (Wayside), 1 Line, 23 Street – 86 Street

	23 Street	28 Street	34 Street - Penn Station	Times Square – 42 Street	50 Street	59 Street – Columbus Circle	66 Street	72 Street	79 Street	86 Street
Simulated Travel Time	B-7									
Average Speeds: Peak Periods	B-8									
Simulated Terminal On-Time Performance & Comparison	B-9, B-26									
Dwell Time Inputs	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*
Terminal Turn Times				F-26						
Routing	F-27									
Operating Variability										
Peak Service Delivery				B-14						
Minimum Supportable Headways	F-277*, F-282*									
Simulated Congestion Locations	B-23									
Station Time Signal Control Line Cutback Events	B-30									
Section F.2 - Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots	F-31									
Section F.3 - Time-Distance ("String") Charts	F-189*									
Section F.4 - Simulated Station Occupancy Charts										

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Table A.4-3. Baseline (Wayside), ① Line, 96 Street – 181 Street

	96 Street	103 Street	110 Street – Cathedral Parkway	116 Street – Columbia University	125 Street	137 Street – City College	145 Street	157 Street	168 Street	181 Street
Simulated Travel Time	B-7									
Average Speeds: Peak Periods	B-8									
Simulated Terminal On-Time Performance & Comparison	B-9, B-26, B-28									
Dwell Time Inputs	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*
Terminal Turn Times										
Routing	F-27									
Operating Variability										
Peak Service Delivery	B-15									
Minimum Supportable Headways	F-277*, F-282*									
Simulated Congestion Locations	B-23									
Station Time Signal Control Line Cutback Events	B-30									
Section F.2 - Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots	F-31, F-32, F-33, F-34									
Section F.3 - Time-Distance (“String”) Charts	F-205*									
Section F.4 - Simulated Station Occupancy Charts										

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Table A.4-4. Baseline (Wayside), 1 Line, 191 Street – Van Cortlandt Park-242 Street

	191 Street	Dyckman Street	207 Street	215 Street	225 Street	231 Street	238 Street	Van Cortlandt Park – 242 Street
Simulated Travel Time	B-7							
Average Speeds: Peak Periods	B-8							
Simulated Terminal On-Time Performance & Comparison	B-9, B-26, B-28							
Dwell Time Inputs	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	
Terminal Turn Times								F-26
Routing	F-27							
Operating Variability								
Peak Service Delivery						B-16		
Minimum Supportable Headways	F-277*, F-282*							
Simulated Congestion Locations	B-23							
Station Time Signal Control Line Cutback Events	B-30							
Section F.2 - Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots	F-32, F-33							
Section F.3 - Time-Distance (“String”) Charts	F-205*							
Section F.4 - Simulated Station Occupancy Charts								F-266*

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Table A.4-5. Baseline (Wayside), ② Line, Flatbush Avenue – Brooklyn College to President Street and ③ Line, New Lots Avenue to Pennsylvania Avenue

	Flatbush Avenue – Brooklyn College	Newkirk Avenue	Beverly Road	Church Avenue	Winthrop Street	Sterling Street	President Street	New Lots Avenue	Van Siclen Avenue	Pennsylvania Avenue
Simulated Travel Time	B-7									
Average Speeds: Peak Periods	B-8									
Simulated Terminal On-Time Performance & Comparison	B-9, B-24									
Dwell Time Inputs		F-17*	F-17*	F-17*	F-17*	F-17*	F-17*		F-17*	F-17*
Terminal Turn Times	F-26							F-26		
Routing	F-27									
Operating Variability										
Peak Service Delivery										
Minimum Supportable Headways	F-277*, F-282*									
Simulated Congestion Locations	B-23									
Station Time Signal Control Line Cutback Events	B-30									
Section F.2 - Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots	F-35, F-44, F-45, F-46									
Section F.3 - Time-Distance (“String”) Charts	F-93*, F-109*									
Section F.4 - Simulated Station Occupancy Charts	F-226*							F-221*		

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Table A.4-6. Baseline (Wayside), ③ Line, Junius Street to Franklin Avenue and ② ③ Line, Franklin Avenue to Grand Army Plaza

	Junius Street	Rockaway Avenue	Saratoga Avenue	Sutter Avenue – Rutland Road	Crown Heights – Utica Avenue	Kingston Avenue	Nostrand Avenue	Franklin Avenue	Eastern Parkway – Brooklyn Museum	Grand Army Plaza
Simulated Travel Time	B-7									
Average Speeds: Peak Periods	B-8									
Simulated Terminal On-Time Performance & Comparison	B-9, B-24									
Dwell Time Inputs	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*
Terminal Turn Times										
Routing	F-27									
Operating Variability										
Peak Service Delivery										
Minimum Supportable Headways	F-277*, F-282*									
Simulated Congestion Locations	B-23									
Station Time Signal Control Line Cutback Events	B-30									
Section F.2 - Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots	F-35, F-44, F-45, F-46, F-47, F-48									
Section F.3 - Time-Distance (“String”) Charts	F-93*, F-109*									
Section F.4 - Simulated Station Occupancy Charts					F-231*					

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Table A.4-7. Baseline (Wayside), ②③ Line, Bergen Street to Chambers Street

	Bergen Street	Atlantic Avenue – Barclays Center	Nevins Street	Hoyt Street	Borough Hall	Clark Street	Wall Street	Fulton Street	Park Place	Chambers Street
Simulated Travel Time	B-7									
Average Speeds: Peak Periods	B-8									
Simulated Terminal On-Time Performance & Comparison	B-9, B-24, B-26									
Dwell Time Inputs	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*
Terminal Turn Times										
Routing	F-27									
Operating Variability			F-28							
Peak Service Delivery			B-11							
Minimum Supportable Headways	F-277*, F-282*									
Simulated Congestion Locations	B-23									
Station Time Signal Control Line Cutback Events	B-30									
Section F.2 - Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots	F-30*									
Section F.3 - Time-Distance (“String”) Charts	F-93*, F-109*			F-189*						
Section F.4 - Simulated Station Occupancy Charts										

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Table A.4-8. Baseline (Wayside), ② ③ Line, 14 Street to 135 Street and ③ Line, 145 Street and Harlem - 148 Street

	14 Street	34 Street – Penn Station	Times Square - 42 Street	72 Street	96 Street	Central Park North – 110 Street	116 Street	125 Street	135 Street	145 Street	Harlem – 148 Street
Simulated Travel Time	B-7										
Average Speeds: Peak Periods	B-8										
Simulated Terminal On-Time Performance & Comparison	B-9, B-26, B-28										
Dwell Time Inputs	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	F-17*	
Terminal Turn Times											
Routing	F-27										
Operating Variability			F-28								
Peak Service Delivery			B-14								
Minimum Supportable Headways	F-277*, F-282*										
Simulated Congestion Locations	B-23										
Station Time Signal Control Line Cutback Events	B-30										
Section F.2 - Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots	F-37, F-38, F-41, F-42										
Section F.3 - Time-Distance ("String") Charts	F-189*										
Section F.4 - Simulated Station Occupancy Charts											F-261*

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Table A.4-9. Baseline (Wayside), 2 5 Line, 149 Street-Grand Concourse to East 180 Street

	149 Street – Grand Concourse LL	3 Avenue – 149 Street	Jackson Avenue	Prospect Avenue	Intervale Avenue	Simpson Street	Freeman Street	174 Street	W Farms Square – East Tremont Avenue	East 180 Street
Simulated Travel Time	B-7									
Average Speeds: Peak Periods	B-8									
Simulated Terminal On-Time Performance & Comparison	B-9, B-26, B-27, B-28, B-29									
Dwell Time Inputs	F-17* F-22*	F-17* F-22*	F-17* F-22*	F-17* F-22*	F-17* F-22*	F-17* F-22*	F-17* F-22*	F-17* F-22*	F-17* F-22*	F-17* F-22*
Terminal Turn Times										
Routing	F-27									
Operating Variability										
Peak Service Delivery										
Minimum Supportable Headways	F-277*, F-282*									
Simulated Congestion Locations	B-23									
Station Time Signal Control Line Cutback Events	B-30									
Section F.2 - Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots	F-38, F-41									
Section F.3 - Time-Distance (“String”) Charts	F-141*, F-157*									
Section F.4 - Simulated Station Occupancy Charts										

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Table A.4-10. Baseline (Wayside), 2 5 Line, Bronx Park East to Nereid Avenue; 2 Line, Wakefield-241 Street

	Bronx Park East	Pelham Parkway	Allerton Avenue	Burke Avenue	Gun Hill Road	219 Street	225 Street	233 Street	Nereid Avenue	Wakefield – 241 Street
Simulated Travel Time	B-7									
Average Speeds: Peak Periods	B-8									
Simulated Terminal On-Time Performance & Comparison	B-9, B-26, B-27, B-28, B-29									
Dwell Time Inputs	F-17* F-22*	F-17* F-22*	F-17* F-22*	F-17* F-22*	F-17* F-22*	F-17* F-22*	F-17* F-22*	F-17* F-22*	F-17*	
Terminal Turn Times										F-26
Routing	F-27									
Operating Variability										
Peak Service Delivery										
Minimum Supportable Headways	F-277*, F-282*									
Simulated Congestion Locations	B-23									
Station Time Signal Control Line Cutback Events	B-30									
Section F.2 - Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots	F-39, F-40									
Section F.3 - Time-Distance (“String”) Charts	F-141*, F-157*									
Section F.4 - Simulated Station Occupancy Charts										F-251*

EXECUTIVE SUMMARY

Table A.4-11. Baseline (Wayside), 5 Line, Morris Park to Eastchester - Dyre Avenue

	Morris Park	Pelham Parkway	Gun Hill Road	Baychester Avenue	Eastchester – Dyre Avenue
Simulated Travel Time	B-7				
Average Speeds: Peak Periods	B-8				
Simulated Terminal On-Time Performance & Comparison	B-9, B-27, B-29				
Dwell Time Inputs	F-22*	F-22*	F-22*	F-22*	
Terminal Turn Times					F-26
Routing	F-27				
Operating Variability					
Peak Service Delivery					
Minimum Supportable Headways	F-277*, F-282*				
Simulated Congestion Locations	B-23				
Station Time Signal Control Line Cutback Events	B-30				
Section F.2 - Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots	F-53, F-54				
Section F.3 - Time-Distance (“String”) Charts	F-157*				
Section F.4 - Simulated Station Occupancy Charts					F-246*

EXECUTIVE SUMMARY

Table A.4-12. Baseline (Wayside), 5 Line, Flatbush Avenue – Brooklyn College to President Street and 4 Line, New Lots Avenue to Pennsylvania Avenue

	Flatbush Avenue – Brooklyn College	Newkirk Avenue	Beverly Road	Church Avenue	Winthrop Street	Sterling Street	President Street	New Lots Avenue	Van Siclen Avenue	Pennsylvania Avenue
Simulated Travel Time	B-7									
Average Speeds: Peak Periods	B-8									
Simulated Terminal On-Time Performance & Comparison	B-9, B-25									
Dwell Time Inputs		F-22*	F-22*	F-22*	F-22*	F-22*	F-22*		F-22*	F-22*
Terminal Turn Times	F-26							F-26		
Routing	F-27									
Operating Variability										
Peak Service Delivery										
Minimum Supportable Headways	F-277*, F-282*									
Simulated Congestion Locations	B-23									
Station Time Signal Control Line Cutback Events	B-30									
Section F.2 - Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots	F-35, F-44, F-47, F-52									
Section F.3 - Time-Distance (“String”) Charts	F-93*, F-109*									
Section F.4 - Simulated Station Occupancy Charts	F-226*							F-221*		

EXECUTIVE SUMMARY

Table A.4-13. Baseline (Wayside), 4 Line, Junius Street to Nostrand Avenue and 4 5 Line, Franklin Avenue to Grand Army Plaza

	Junius Street	Rockaway Avenue	Saratoga Avenue	Sutter Avenue – Rutland Road	Crown Heights – Utica Avenue	Kingston Avenue	Nostrand Avenue	Franklin Avenue	Eastern Parkway – Brooklyn Museum	Grand Army Plaza
Simulated Travel Time	B-7									
Average Speeds: Peak Periods	B-8									
Simulated Terminal On-Time Performance & Comparison	B-9, B-25									
Dwell Time Inputs	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*
Terminal Turn Times										
Routing	F-27									
Operating Variability										
Peak Service Delivery										
Minimum Supportable Headways	F-277*, F-282*									
Simulated Congestion Locations	B-23									
Station Time Signal Control Line Cutback Events	B-30									
Section F.2 - Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots	F-35, F-44, F-45, F-46, F-47, F-48									
Section F.3 - Time-Distance (“String”) Charts	F-93*, F-109*									
Section F.4 - Simulated Station Occupancy Charts					F-231*					

EXECUTIVE SUMMARY

Table A.4-14. Baseline (Wayside), 4 5 Line, Bergen Street to Grand Central – 42 Street

	Bergen Street	Atlantic Avenue – Barclays Center	Nevins Street	Borough Hall	Bowling Green	Wall Street	Fulton Street	Brooklyn Bridge – City Hall	14 Street – Union Square	Grand Central – 42 Street
Simulated Travel Time	B-7									
Average Speeds: Peak Periods	B-8									
Simulated Terminal On-Time Performance & Comparison	B-9, B-25, B-27, B-29									
Dwell Time Inputs	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*
Terminal Turn Times										
Routing	F-27									
Operating Variability			F-28							
Peak Service Delivery			B-11							
Minimum Supportable Headways	F-277*, F-282*									
Simulated Congestion Locations	B-23									
Station Time Signal Control Line Cutback Events	B-30									
Section F.2 - Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots	F-47, F-52									
Section F.3 - Time-Distance ("String") Charts	F-61*, F-77*, F-109*									
Section F.4 - Simulated Station Occupancy Charts										

EXECUTIVE SUMMARY

Table A.4-15. Baseline (Wayside), 4 5 Line, 59 Street to 138 Street-Grand Concourse and 4 Line, 149 Street – Grand Concourse to 176 Street

	59 Street	86 Street	125 Street	138 Street – Grand Concourse	149 Street - Grand Concourse	161 Street – Yankee Stadium	167 Street	170 Street	Mt Eden Avenue	176 Street
Simulated Travel Time	B-7									
Average Speeds: Peak Periods	B-8									
Simulated Terminal On-Time Performance & Comparison	B-9, B-27, B-29									
Dwell Time Inputs	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*
Terminal Turn Times										
Routing	F-27									
Operating Variability										
Peak Service Delivery										
Minimum Supportable Headways	F-277*, F-282*									
Simulated Congestion Locations	B-23									
Station Time Signal Control Line Cutback Events	B-30									
Section F.2 - Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots	F-47, F-48, F-51, F-52									
Section F.3 - Time-Distance (“String”) Charts	F-61*, F-173*									
Section F.4 - Simulated Station Occupancy Charts										

EXECUTIVE SUMMARY

Table A.4-16. Baseline (Wayside), 4 Line, Burnside Avenue to Woodlawn

	Burnside Avenue	183 Street	Fordham Road	Kingsbridge Road	Bedford Park Boulevard – Lehman College	Mosholu Parkway	Woodlawn
Simulated Travel Time	B-7						
Average Speeds: Peak Periods	B-8						
Simulated Terminal On-Time Performance & Comparison	B-9, B-27, B-29						
Dwell Time Inputs	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	
Terminal Turn Times							F-26
Routing	F-27						
Operating Variability							
Peak Service Delivery							
Minimum Supportable Headways	F-277*, F-282*						
Simulated Congestion Locations	B-23						
Station Time Signal Control Line Cutback Events	B-30						
Section F.2 - Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots	F-48, F-49, F-50, F-51						
Section F.3 - Time-Distance (“String”) Charts	F-173*						
Section F.4 - Simulated Station Occupancy Charts							F-256*

EXECUTIVE SUMMARY

Table A.4-17. Baseline (Wayside), 6 Line, Brooklyn Bridge-City Hall to Grand Central - 42 Street

	Brooklyn Bridge - City Hall	Canal Street	Spring Street	Bleecker Street	Astor Place	14 Street – Union Square	23 Street	28 Street	33 Street	Grand Central – 42 Street
Simulated Travel Time	B-7									
Average Speeds: Peak Periods	B-8									
Simulated Terminal On-Time Performance & Comparison	B-9, B-27									
Dwell Time Inputs		F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*
Terminal Turn Times										
Routing	F-27									
Operating Variability										
Peak Service Delivery										
Minimum Supportable Headways	F-277*, F-282*									
Simulated Congestion Locations	B-23									
Station Time Signal Control Line Cutback Events	B-30									
Section F.2 - Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots	F-55, F-58									
Section F.3 - Time-Distance (“String”) Charts	F-61*									
Section F.4 - Simulated Station Occupancy Charts	F-236*									

EXECUTIVE SUMMARY

Table A.4-18. Baseline (Wayside), 6 Line, 51 Street to 125 Street

	51 Street	59 Street	68 Street - Hunter College	77 Street	86 Street	96 Street	103 Street	110 Street	116 Street	125 Street
Simulated Travel Time	B-7									
Average Speeds: Peak Periods	B-8									
Simulated Terminal On-Time Performance & Comparison	B-9, B-27									
Dwell Time Inputs	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*
Terminal Turn Times										
Routing	F-27									
Operating Variability										
Peak Service Delivery										
Minimum Supportable Headways	F-277*, F-282*									
Simulated Congestion Locations	B-23									
Station Time Signal Control Line Cutback Events	B-30									
Section F.2 - Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots	F-55, F-58									
Section F.3 - Time-Distance ("String") Charts	F-61*									
Section F.4 - Simulated Station Occupancy Charts										

EXECUTIVE SUMMARY

Table A.4-19. Baseline (Wayside), 6 Line, 3 Avenue – 138 Street to Elder Avenue

	3 Avenue – 138 Street	Brook Avenue	Cypress Avenue	East 143 Street	East 149 Street	Longwood Avenue	Hunts Point Avenue	Whitlock Avenue	Elder Avenue
Simulated Travel Time	B-7								
Average Speeds: Peak Periods	B-8								
Simulated Terminal On-Time Performance & Comparison	B-9, B-27								
Dwell Time Inputs	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*
Terminal Turn Times	F-26								
Routing	F-27								
Operating Variability									
Peak Service Delivery									
Minimum Supportable Headways	F-277*, F-282*								
Simulated Congestion Locations	B-23								
Station Time Signal Control Line Cutback Events	B-30								
Section F.2 - Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots	F-56, F-57								
Section F.3 - Time-Distance ("String") Charts	F-125*								
Section F.4 - Simulated Station Occupancy Charts									

EXECUTIVE SUMMARY

Table A.4-20. Baseline (Wayside), 6 Line, Morrison Avenue - Soundview to Pelham Bay Park

	Morrison Avenue – Soundview	St. Lawrence Avenue	Parkchester	Castle Hill Avenue	Zerega Avenue	Westchester Square – East Tremont Avenue	Buhre Avenue	Middletown Road	Pelham Bay Park
Simulated Travel Time	B-7								
Average Speeds: Peak Periods	B-8								
Simulated Terminal On-Time Performance & Comparison	B-9, B-27								
Dwell Time Inputs	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	F-22*	
Terminal Turn Times	F-26								
Routing	F-27								
Operating Variability									
Peak Service Delivery									
Minimum Supportable Headways	F-277*, F-282*								
Simulated Congestion Locations	B-23								
Station Time Signal Control Line Cutback Events	B-30								
Section F.2 - Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots	F-56, F-57								
Section F.3 - Time-Distance (“String”) Charts	F-125*								
Section F.4 - Simulated Station Occupancy Charts									F-241*

EXECUTIVE SUMMARY

Table A.4-21. Future CBTC Baseline, 1 Line, South Ferry – 18 Street

	South Ferry	Rector Street	Cortlandt Street - WTC	Chambers Street	Franklin Street	Canal Street	Houston Street	Christopher Street	14 Street	18 Street
Average Speeds: Peak Periods	C-4									
Simulated Terminal On-Time Performance & Comparison by Line (Wayside and CBTC)	C-12									
Dwell Time Inputs		G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*
Terminal Turn Times	G-27*									
Routing	G-29									
Operating Variability	G-30									
Peak Service Delivery										
Simulated Congestion Locations – Future CBTC										
Section G.2 – Future Baseline (CBTC) Operating Plan	G-33*									
Section G.3 – CBTC Network Capacity & Peak Simulated Service	G-77*									
Section G.4 – Time-Distance Charts	G-220*									
Section G.5 - Simulated Station Occupancy Charts	G-299*									

EXECUTIVE SUMMARY

Table A.4-22. Future CBTC Baseline, 1 Line, 23 Street – 86 Street

	23 Street	28 Street	34 Street - Penn Station	Times Square – 42 Street	50 Street	59 Street – Columbus Circle	66 Street	72 Street	79 Street	86 Street
Average Speeds: Peak Periods	C-4									
Simulated Terminal On-Time Performance & Comparison by Line (Wayside and CBTC)	C-12									
Dwell Time Inputs	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*
Terminal Turn Times										
Routing	G-29									
Operating Variability	G-30									
Peak Service Delivery										
Simulated Congestion Locations – Future CBTC										
Section G.2 – Future Baseline (CBTC) Operating Plan	G-33*									
Section G.3 – CBTC Network Capacity & Peak Simulated Service	G-77*									
Section G.4 – Time-Distance Charts				G-220*						
Section G.5 - Simulated Station Occupancy Charts										

EXECUTIVE SUMMARY

Table A.4-23. Future CBTC Baseline, 1 Line, 96 Street – 181 Street

	96 Street	103 Street	110 Street – Cathedral Parkway	116 Street – Columbia University	125 Street	137 Street – City College	145 Street	157 Street	168 Street	181 Street
Average Speeds: Peak Periods	C-4									
Simulated Terminal On-Time Performance & Comparison by Line (Wayside and CBTC)	C-12									
Dwell Time Inputs	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*
Terminal Turn Times										
Routing	G-29									
Operating Variability	G-30									
Peak Service Delivery	C-22									
Simulated Congestion Locations – Future CBTC										
Section G.2 – Future Baseline (CBTC) Operating Plan	G-33*									
Section G.3 – CBTC Network Capacity & Peak Simulated Service	G-77*									
Section G.4 – Time-Distance Charts	G-236*									
Section G.5 - Simulated Station Occupancy Charts										

EXECUTIVE SUMMARY

Table A.4-24. Future CBTC Baseline, 1 Line, 191 Street – Van Cortlandt Park-242 Street

	191 Street	Dyckman Street	207 Street	215 Street	225 Street	231 Street	238 Street	Van Cortlandt Park – 242 Street
Average Speeds: Peak Periods	C-4							
Simulated Terminal On-Time Performance & Comparison by Line (Wayside and CBTC)	C-12							
Dwell Time Inputs	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	
Terminal Turn Times								G-27*
Routing	G-29							
Operating Variability	G-30							
Peak Service Delivery						C-24		
Terminal Capacity								C-52
Simulated Congestion Locations – Future CBTC								
Section G.2 – Future Baseline (CBTC) Operating Plan	G-33*							
Section G.3 – CBTC Network Capacity & Peak Simulated Service	G-77*							
Section G.4 – Time-Distance Charts	G-236*							
Section G.5 - Simulated Station Occupancy Charts								G-294*

EXECUTIVE SUMMARY

Table A.4-25. Future CBTC Baseline, ② Line, Flatbush Avenue – Brooklyn College to President Street and ③ Line, New Lots Avenue to Pennsylvania Avenue

	Flatbush Avenue – Brooklyn College	Newkirk Avenue	Beverly Road	Church Avenue	Winthrop Street	Sterling Street	President Street	New Lots Avenue	Van Siclen Avenue	Pennsylvania Avenue
Average Speeds: Peak Periods	C-4									
Simulated Terminal On-Time Performance & Comparison by Line (Wayside and CBTC)	C-12									
Dwell Time Inputs		G-18*	G-18*	G-18*	G-18*	G-18*	G-18*		G-18*	G-18*
Terminal Turn Times	G-27*							G-27*		
Routing	G-29									
Operating Variability	G-30									
Peak Service Delivery										
Terminal Capacity	C-46							C-49		
Simulated Congestion Locations – Future CBTC										
Section G.2 – Future Baseline (CBTC) Operating Plan	G-43*, G-49*									
Section G.3 – CBTC Network Capacity & Peak Simulated Service	G-77*									
Section G.4 – Time-Distance Charts	G-140*							G-124*		
Section G.5 - Simulated Station Occupancy Charts	G-258*							G-254*		

EXECUTIVE SUMMARY

Table A.4-26. Future CBTC Baseline, ③ Line, Junius Street to Franklin Avenue and ② ③ Line, Franklin Avenue to Grand Army Plaza

	Junius Street	Rockaway Avenue	Saratoga Avenue	Sutter Avenue 6 Rutland Road	Crown Heights – Utica Avenue	Kingston Avenue	Nostrand Avenue	Franklin Avenue	Eastern Parkway – Brooklyn Museum	Grand Army Plaza
Average Speeds: Peak Periods	C-4									
Simulated Terminal On-Time Performance & Comparison by Line (Wayside and CBTC)	C-12									
Dwell Time Inputs	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*
Terminal Turn Times					G-27*					
Routing	G-29									
Operating Variability	G-30									
Peak Service Delivery										
Terminal Capacity					C-48					
Simulated Congestion Locations – Future CBTC					C-32					
Section G.2 – Future Baseline (CBTC) Operating Plan	G-43*, G-49*									
Section G.3 – CBTC Network Capacity & Peak Simulated Service	G-77*									
Section G.4 – Time-Distance Charts	G-124*, G-140*									
Section G.5 - Simulated Station Occupancy Charts					G-263*					

EXECUTIVE SUMMARY

Table A.4-27. Future CBTC Baseline, ② ③ Line, Bergen Street to Chambers Street

	Bergen Street	Atlantic Avenue – Barclays Center	Nevens Street	Hoyt Street	Borough Hall	Clark Street	Wall Street	Fulton Street	Park Place	Chambers Street
Average Speeds: Peak Periods	C-4									
Simulated Terminal On-Time Performance & Comparison by Line (Wayside and CBTC)	C-12									
Dwell Time Inputs	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*
Terminal Turn Times										
Routing	G-29									
Operating Variability	G-30									
Peak Service Delivery			C-18							
Terminal Capacity										
Simulated Congestion Locations – Future CBTC										
Section G.2 – Future Baseline (CBTC) Operating Plan	G-43*, G-49*									
Section G.3 – CBTC Network Capacity & Peak Simulated Service	G-77*									
Section G.4 – Time-Distance Charts	G-124*, G-140*			G-220*						
Section G.5 - Simulated Station Occupancy Charts										

EXECUTIVE SUMMARY

Table A.4-28. Future CBTC Baseline, 2 3 Line, 14 Street to 135 Street and 3 Line, 145 Street and Harlem - 148 Street

	14 Street	34 Street – Penn Station	Times Square - 42 Street	72 Street	96 Street	Central Park North – 110 Street	116 Street	125 Street	135 Street	145 Street	Harlem – 148 Street
Average Speeds: Peak Periods	C-4										
Simulated Terminal On-Time Performance & Comparison by Line (Wayside and CBTC)	C-12										
Dwell Time Inputs	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	G-18*	
Terminal Turn Times											G-27*
Routing	G-29										
Operating Variability	G-30										
Peak Service Delivery			C-21		C-22					C-25	
Terminal Capacity											C-50
Simulated Congestion Locations – Future CBTC											C-32
Section G.2 – Future Baseline (CBTC) Operating Plan	G-43*, G-49*										
Section G.3 – CBTC Network Capacity & Peak Simulated Service	G-77*										
Section G.4 – Time-Distance Charts	G-220*										
Section G.5 - Simulated Station Occupancy Charts											G-289*

EXECUTIVE SUMMARY

Table A.4-29. Future CBTC Baseline, 2 5 Line, 149 Street-Grand Concourse to East 180 Street

	149 Street – Grand Concourse LL	3 Avenue – 149 Street	Jackson Avenue	Prospect Avenue	Intervale Avenue	Simpson Street	Freeman Street	174 Street	West Farms Square – E Tremont Avenue	East 180 Street
Average Speeds: Peak Periods	C-4									
Simulated Terminal On-Time Performance & Comparison by Line (Wayside and CBTC)	C-12									
Dwell Time Inputs	G-18* G-23*	G-18* G-23*	G-18* G-23*	G-18* G-23*	G-18* G-23*	G-18* G-23*	G-18* G-23*	G-18* G-23*	G-18* G-23*	G-18* G-23*
Terminal Turn Times										
Routing	G-29									
Operating Variability	G-30									
Peak Service Delivery										C-23
Terminal Capacity										
Simulated Congestion Locations – Future CBTC										
Section G.2 – Future Baseline (CBTC) Operating Plan	G-43*, G-62*									
Section G.3 – CBTC Network Capacity & Peak Simulated Service	G-77*									
Section G.4 – Time-Distance Charts	G-172*, G-188*									
Section G.5 - Simulated Station Occupancy Charts										

EXECUTIVE SUMMARY

Table A.4-30. Future CBTC Baseline, 2 5 Line, Bronx Park East to Nereid Avenue; 2 Line, Wakefield-241 Street

	Bronx Park East	Pelham Parkway	Allerton Avenue	Burke Avenue	Gun Hill Road	219 Street	225 Street	233 Street	Nereid Avenue	Wakefield – 241 Street
Average Speeds: Peak Periods	C-4									
Simulated Terminal On-Time Performance & Comparison by Line (Wayside and CBTC)	C-12									
Dwell Time Inputs	G-18* G-23*	G-18* G-23*	G-18* G-23*	G-18* G-23*	G-18* G-23*	G-18* G-23*	G-18* G-23*	G-18* G-23*	G-18*	
Terminal Turn Times										G-27*
Routing	G-29									
Operating Variability	G-30									
Peak Service Delivery										
Terminal Capacity										C-51
Simulated Congestion Locations – Future CBTC										
Section G.2 – Future Baseline (CBTC) Operating Plan	G-43*, G-62*									
Section G.3 – CBTC Network Capacity & Peak Simulated Service	G-77*									
Section G.4 – Time-Distance Charts	G-172*									
Section G.5 - Simulated Station Occupancy Charts							G-281*			

EXECUTIVE SUMMARY

Table A.4-31. Future CBTC Baseline, 5 Line, Morris Park to Eastchester - Dyre Avenue

	Morris Park	Pelham Parkway	Gun Hill Road	Baychester Avenue	Eastchester – Dyre Avenue
Average Speeds: Peak Periods	C-4				
Simulated Terminal On-Time Performance & Comparison by Line (Wayside and CBTC)	C-12				
Dwell Time Inputs	G-23*	G-23*	G-23*	G-23*	
Terminal Turn Times					G-27*
Routing	G-29				
Operating Variability	G-30				
Peak Service Delivery				C-27	
Terminal Capacity					C-54
Simulated Congestion Locations – Future CBTC					
Section G.2 – Future Baseline (CBTC) Operating Plan	G-62*				
Section G.3 – CBTC Network Capacity & Peak Simulated Service	G-77*				
Section G.4 – Time-Distance Charts	G-188*				
Section G.5 - Simulated Station Occupancy Charts					G-276*

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Table A.4-32. Future CBTC Baseline, 5 Line, Flatbush Avenue – Brooklyn College to President Street and 4 Line, New Lots Avenue to Pennsylvania Avenue

	Flatbush Avenue – Brooklyn College	Newkirk Avenue	Beverly Road	Church Avenue	Winthrop Street	Sterling Street	President Street	New Lots Avenue	Van Siclen Avenue	Pennsylvania Avenue
Average Speeds: Peak Periods	C-4									
Simulated Terminal On-Time Performance & Comparison by Line (Wayside and CBTC)	C-12									
Dwell Time Inputs		G-23*	G-23*	G-23*	G-23*	G-23*	G-23*		G-23*	G-23*
Terminal Turn Times	G-27*							G-27*		
Routing	G-29									
Operating Variability	G-30									
Peak Service Delivery										
Terminal Capacity	C-46							C-49		
Simulated Congestion Locations – Future CBTC										
Section G.2 – Future Baseline (CBTC) Operating Plan	G-62*							G-55*		
Section G.3 – CBTC Network Capacity & Peak Simulated Service	G-77*									
Section G.4 – Time-Distance Charts	G-140*							G-124*		
Section G.5 - Simulated Station Occupancy Charts	G-258*							G-254*		

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Table A.4-33. Future CBTC Baseline Calibration, 4 Line, Junius Street to Nostrand Avenue and 4 5 Line, Franklin Avenue to Grand Army Plaza

	Junius Street	Rockaway Avenue	Saratoga Avenue	Sutter Avenue – Rutland Road	Crown Heights – Utica Avenue	Kingston Avenue	Nostrand Avenue	Franklin Avenue	Eastern Parkway – Brooklyn Museum	Grand Army Plaza
Average Speeds: Peak Periods	C-4									
Simulated Terminal On-Time Performance & Comparison by Line (Wayside and CBTC)	C-12									
Dwell Time Inputs	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*
Terminal Turn Times					G-27*					
Routing	G-29									
Operating Variability	G-30									
Peak Service Delivery										
Terminal Capacity					C-48					
Simulated Congestion Locations – Future CBTC					C-32					
Section G.2 – Future Baseline (CBTC) Operating Plan	G-55*							G-55*, G-62*		
Section G.3 – CBTC Network Capacity & Peak Simulated Service	G-77*									
Section G.4 – Time-Distance Charts	G-124*							G-124*, G-140*		
Section G.5 - Simulated Station Occupancy Charts					G-263*					

EXECUTIVE SUMMARY

Table A.4-34. Future CBTC Baseline, 4 5 Line, Bergen Street to Grand Central – 42 Street

	Bergen Street	Atlantic Avenue – Barclays Centre	Nevins Street	Borough Hall	Bowling Green	Wall Street	Fulton Street	Brooklyn Bridge – City Hall	14 Street – Union Square	Grand Central – 42 Street
Average Speeds: Peak Periods	C-4									
Simulated Terminal On-Time Performance & Comparison by Line (Wayside and CBTC)	C-12									
Dwell Time Inputs	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*
Terminal Turn Times										
Routing	G-29									
Operating Variability	G-30									
Peak Service Delivery			C-18							C-19
Terminal Capacity										
Simulated Congestion Locations – Future CBTC								C-32	C-32	
Section G.2 – Future Baseline (CBTC) Operating Plan	G-55*, G-62*									
Section G.3 – CBTC Network Capacity & Peak Simulated Service	G-77*									
Section G.4 – Time-Distance Charts	G-124*, G-140*			G-108*, G-92*						
Section G.5 - Simulated Station Occupancy Charts								G-268*		

EXECUTIVE SUMMARY

Table A.4-35. Future CBTC Baseline, 4 5 Line, 59 Street to 138 Street-Grand Concourse and 4 Line, 149 Street – Grand Concourse to 176 Street

	59 Street	86 Street	125 Street	138 Street – Grand Concourse	149 Street – Grand Concourse	161 Street – Yankee Stadium	167 Street	170 Street	Mt Eden Avenue	176 Street
Average Speeds: Peak Periods	C-4									
Simulated Terminal On-Time Performance & Comparison by Line (Wayside and CBTC)	C-12									
Dwell Time Inputs	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*
Terminal Turn Times										
Routing	G-29									
Operating Variability	G-30									
Peak Service Delivery			C-20							
Terminal Capacity										
Simulated Congestion Locations – Future CBTC										
Section G.2 – Future Baseline (CBTC) Operating Plan	G-55*, G-62*			G-55*						
Section G.3 – CBTC Network Capacity & Peak Simulated Service	G-77*									
Section G.4 – Time-Distance Charts	G-92*				G-204*					
Section G.5 - Simulated Station Occupancy Charts										

EXECUTIVE SUMMARY

Table A.4-36. Future CBTC Baseline, 4 Line, Burnside Avenue to Woodlawn

	Burnside Avenue	183 Street	Fordham Road	Kingsbridge Road	Bedford Park Boulevard – Lehman College	Mosholu Parkway	Woodlawn
Average Speeds: Peak Periods	C-4						
Simulated Terminal On-Time Performance & Comparison by Line (Wayside and CBTC)	C-12						
Dwell Time Inputs	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	
Terminal Turn Times							G-27*
Routing	G-29						
Operating Variability	G-30						
Peak Service Delivery	C-26						
Terminal Capacity							C-53
Simulated Congestion Locations – Future CBTC							
Section G.2 – Future Baseline (CBTC) Operating Plan	G-55*						
Section G.3 – CBTC Network Capacity & Peak Simulated Service	G-77*						
Section G.4 – Time-Distance Charts	G-204*						
Section G.5 - Simulated Station Occupancy Charts							G-285*

EXECUTIVE SUMMARY

Table A.4-37. Future CBTC Baseline, 6 Line, Brooklyn Bridge-City Hall to Grand Central - 42 Street

	Brooklyn Bridge - City Hall	Canal Street	Spring Street	Bleecker Street	Astor Place	14 Street – Union Square	23 Street	28 Street	33 Street	Grand Central – 42 Street
Average Speeds: Peak Periods	C-4									
Simulated Terminal On-Time Performance & Comparison by Line (Wayside and CBTC)	C-12									
Dwell Time Inputs		G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*
Terminal Turn Times										
Routing	G-29									
Operating Variability	G-30									
Peak Service Delivery										C-19
Terminal Capacity										
Simulated Congestion Locations – Future CBTC	C-32					C-32				
Section G.2 – Future Baseline (CBTC) Operating Plan	G-67*									
Section G.3 – CBTC Network Capacity & Peak Simulated Service	G-77*									
Section G.4 – Time-Distance Charts	G-92*									
Section G.5 - Simulated Station Occupancy Charts	G-268*									

EXECUTIVE SUMMARY

Table A.4-38. Future CBTC Baseline, 6 Line, 51 Street to 125 Street

	51 Street	59 Street	68 Street - Hunter College	77 Street	86 Street	96 Street	103 Street	110 Street	116 Street	125 Street
Average Speeds: Peak Periods	C-4									
Simulated Terminal On-Time Performance & Comparison by Line (Wayside and CBTC)	C-12									
Dwell Time Inputs	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*
Terminal Turn Times										
Routing	G-29									
Operating Variability	G-30									
Peak Service Delivery										C-20
Terminal Capacity										
Simulated Congestion Locations – Future CBTC										
Section G.2 – Future Baseline (CBTC) Operating Plan	G-67*									
Section G.3 – CBTC Network Capacity & Peak Simulated Service	G-77*									
Section G.4 – Time-Distance Charts	G-92*									
Section G.5 - Simulated Station Occupancy Charts										

EXECUTIVE SUMMARY

Table A.4-39. Future CBTC Baseline, 6 Line, 3 Avenue - 138 Street to Elder Avenue

	3 Avenue – 138 Street	Brook Avenue	Cypress Avenue	East 143 Street	East 149 Street	Longwood Avenue	Hunts Point Avenue	Whitlock Avenue	Elder Avenue
Average Speeds: Peak Periods	C-4								
Simulated Terminal On-Time Performance & Comparison by Line (Wayside and CBTC)	C-12								
Dwell Time Inputs	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*
Terminal Turn Times									
Routing	G-29								
Operating Variability	G-30								
Peak Service Delivery							C-28		
Terminal Capacity									
Simulated Congestion Locations – Future CBTC									
Section G.2 – Future Baseline (CBTC) Operating Plan	G-67*								
Section G.3 – CBTC Network Capacity & Peak Simulated Service	G-77*								
Section G.4 – Time-Distance Charts	G-92* G-156*	G-156*							
Section G.5 - Simulated Station Occupancy Charts									

EXECUTIVE SUMMARY

Table A.4-40. Future CBTC Baseline, 6 Line, Morrison Avenue - Soundview to Pelham Bay Park

	Morrison Avenue – Soundview	St. Lawrence Avenue	Parkchester	Castle Hill Avenue	Zerega Avenue	Westchester Square – East Tremont Avenue	Middletown Road	Buhre Avenue	Pelham Bay Park
Average Speeds: Peak Periods	C-4								
Simulated Terminal On-Time Performance & Comparison by Line (Wayside and CBTC)	C-12								
Dwell Time Inputs	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	G-23*	
Terminal Turn Times			G-27*						G-27*
Routing	G-29								
Operating Variability	G-30								
Peak Service Delivery									
Terminal Capacity									C-54
Simulated Congestion Locations – Future CBTC									C-32
Section G.2 – Future Baseline (CBTC) Operating Plan	G-67*								
Section G.3 – CBTC Network Capacity & Peak Simulated Service	G-77*								
Section G.4 – Time-Distance Charts	G-156*								
Section G.5 - Simulated Station Occupancy Charts									G-272*



IRT CAPACITY STUDY

1 2 3 4 5 6 S LINES

B - BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM



Prepared for:



by:
STV

Document Number: LTK.C4855.05.01

BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

B.0 Revision History – This Section

Revision No.	Date	Description of Revision
0	July 12, 2019	Initial Release
1	April 14, 2020	Updated to reflect full Phase I-IV simulation results
2	June 10, 2020	Updated to incorporate NYCT review comments
3	July 31, 2020	Final Release

BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

B.1 Introduction

For the introduction to this study, including a description of the study area and phases, and study methodology, refer to Part A of this report.

BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

B.2 Summary

This Technical Memorandum details the A-Division full-network (Phase I-IV) simulation database development and calibration effort for existing NYCT operations using the TrainOps® software developed by LTK. It includes descriptions of all input data, assumptions and methodologies which were used to produce the simulation and calibrate results to typical “real world” operation. It also confirms and quantifies many capacity constraints (“choke points”) that are well-known to NYCT. The model highlights significant capacity constraints at the following locations, with additional detail provided in Section B.3.4:

- **Brooklyn**

- a) **Nostrand Junction** [Page D-10], where 5 Line service conflicts with 2 Line and 3 Line service, causing a loss of capacity on all lines.
- b) **Flatbush Avenue / Brooklyn College** [Page D-3] terminal operations, where lack of buffer (overrun) tracks and tight terminal track geometry constrain terminal capacity. This constraint is exacerbated by the side platform layout, prompting NYCT’s decision to maintain dedicated tracks for the 2 Line and 5 Line for passenger and crew convenience.
- c) **New Lots Avenue** [Page D-9] terminal, where tight terminal track geometry and an interlocking governing entrance to Livonia Yard constrain terminal capacity, compounded by frequent turning 3 Line trains conflicting with yard put-ins and pull-outs for the 3 Line plus some “overflow” 2 Line, 4 Line, and 5 Line trains.
- d) **Crown Heights - Utica Avenue** [Page D-7] terminal, where passenger connections are made between the 3 Line and 4 Line services and where the 4 Line utilizes a relay-type turnback with relay Train Operators.

- **Manhattan**

- a) The Lexington Avenue Line between **14 Street - Union Square** [Page D-23] and **Grand Central - 42 Street** [Page D-26] where long dwell times on the 4 and 5 Line trains (including significant passenger transfers and dwell time impacts of the platform gap fillers in the southbound direction at 14 Street), high scheduled train volumes and civil speed restrictions entering and leaving these two stations cause congestion.
- b) The Lexington Avenue Line at **125 Street** [Page D-34] where long dwell times on the 4 and 5 Line trains (including dwell time impacts of significant transfers with the 6 Line) and slow speeds associated with “forced” diverge routes (all trains must use the reverse leg of switches in order to continue on their normal route) cause congestion.
- c) The **142 Street flat junction** [Page D-43] where southbound 2 Line trains from the Bronx conflict with 3 Line trains to the **Harlem - 148 Street** [Page D-43] terminal at a diamond crossing, causing a loss of capacity on both lines.

BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

- **The Bronx**

- a) **Van Cortlandt Park - 242 Street** [Page D-45] terminal operation where the 1 Line trains entering or leaving service must perform a double reverse move (once on the center track at 238 Street, once at the terminal) to operate between yard and terminal, conflicting with a high volume of southbound revenue trains from Van Cortlandt Park - 242 Street.
- b) The complex “slot swapping” and merging operation of the 5 Line trains between 3 Avenue - 149 Street and the Lexington Avenue Line Harlem River Tubes where this southbound service leaves the shared operation with the 2 Line and then merges with the 4 Line between 149 Street - Grand Concourse and 138 Street - Grand Concourse or just south of 138 Street (depending on time of day) with the reverse diverges and merges occurring northbound.
- c) **Wakefield - 241 Street** [Page D-56] terminal operation where the 2 Line trains entering or leaving service must perform a double reverse move (once on the center track at Nereid Avenue, once at the terminal) to operate between yard and terminal, conflicting with a high volume of northbound revenue trains and compounded by 5 Line trains operating directly from the yard to Nereid Avenue in the morning and from Nereid Avenue directly to the yard in the evening (with extended dwells at Nereid Avenue to sweep trains of passengers before proceeding to the yard).

Calibration results include simulated velocity profiles (which are compared with actual NYCT event recorder data from A-Division trips), end terminal on-time performance (which is compared with NYCT-reported data for the 12 months ending in November 2019), average speeds, travel times, peak service delivery (simulated versus scheduled), time-distance string charts, terminal occupancy charts and delay locations across the simulated network.

The TrainOps® simulation results were used to calculate minimum supportable headways and the corresponding theoretical trains per hour across all services and tracks in the study area. The minimum supportable headway analysis was then used to develop overall network capacity graphics for morning and evening peak periods. Minimum supportable headway tables and network capacity graphics are included in Section B.3.4, using the NYCT operating plan as the basis for the calibrated model. Detailed morning and evening peak service capacity for the above locations and all other station-station pairs throughout the network is provided in Section F.4.

The capacities of the terminals are based on terminal microsimulations developed using the TrainOps® database of the A-Division network. These analyses are conducted by simulated batches of trains at a set initial aggressive headway from a station approaching to the terminal to the terminal itself and then return. Simulations, which measure the resultant throughput leaving the terminal area, are based on full-length trains of the type that normally uses the terminal under analysis with the same schedule margin as is used in the calibrated network simulation.

BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

B.3 Calibration Results

Calibration results include simulated velocity profiles (which are compared with actual NYCT event recorder data from A-Division trips), end terminal on-time performance (which is compared with NYCT-reported data from the last year), average speeds, peak service delivery (simulated versus scheduled), time-distance string charts, terminal occupancy charts and delay locations across the simulated network. The future CBTC simulation scenarios, reported in Part C of this study report, compare improvements versus existing operation in terms of end-terminal on-time performance, average speeds and peak service delivery.

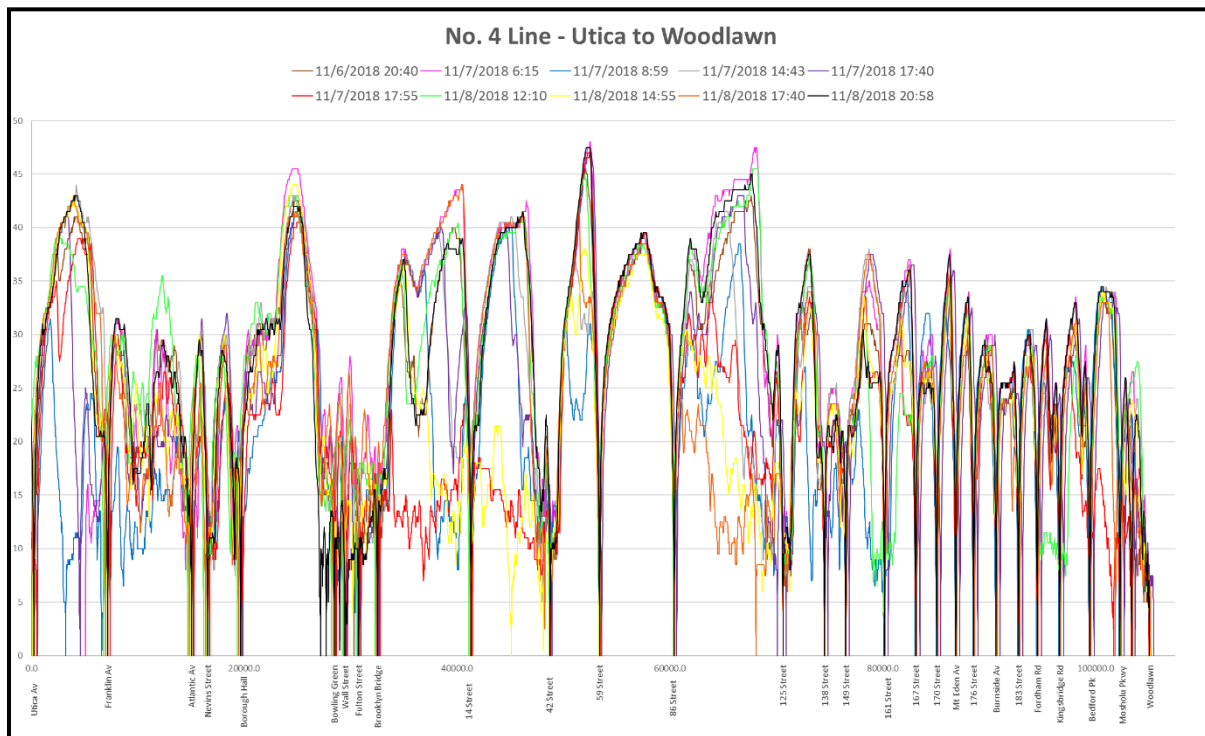
The input data, assumptions, and methodology used to produce the wayside calibration results in this section are included in Section F.1.

B.3.1 Velocity Profiles and Travel Time Results

B.3.1.1 Velocity Profiles

NYCT Division of Car Equipment provided vehicle event recorder data for A-Division trips on each line in the study area. The data include many parameters applicable to vehicle diagnostics and incident investigations; only time and velocity data were applicable to the A-Division simulation effort. Some NYCT vehicles have two velocity channels: the traditional tachometer (axle counter) output and Doppler radar output. The two velocity outputs were found to track very closely and an average of the two was used. For an example refer to Figure B.3-1.

Figure B.3-1. Example of A-Division Event Recorder Data



BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

The STV Team converted the velocity versus time into velocity versus distance plots. The data is not geo-coded but the NYCT Division of Operations Planning was able to provide Automated Train Supervision (ATS) data for the subject vehicles that allowed the locations of interest to be plotted. Multiple trips were overlaid to provide a sense of typical congestion and Train Operator behavior, as shown in Figure B.3-1. The station-to-station pairs show a wide variety of conditions; for example, all ten trips between 59 Street and 86 Street show delay-free operation with very little variation in train operations, whereas the trips between Brooklyn Bridge and Grand Central - 42 Street show several trips with significant delays. Some variation among trips through areas such as Nostrand Junction likely is due to different Train Operator responses to Grade Time (GT) signals.

A full set of event recorder data used in the calibration process is shown in Section F.2. The event recorder data includes TrainOps® velocity profiles overlays for each line simulated. The TrainOps® velocity profiles were generated from single trip simulations without delays and thus reflect a simulated “best case scenario.”

B.3.1.2 Simulated Travel Times by Line

Table B.3-1 shows simulated travel times by line, reflecting results for the morning and evening peak periods. Only trips operating entirely within the 6 a.m. to 10 a.m. or 3 p.m. to 7 p.m. time periods are reflected. The table shows minimum, maximum and average travel times by line by direction. Morning and evening peak period results are shown separately and combined.

Table B.3-1. Simulated Travel Times by Line

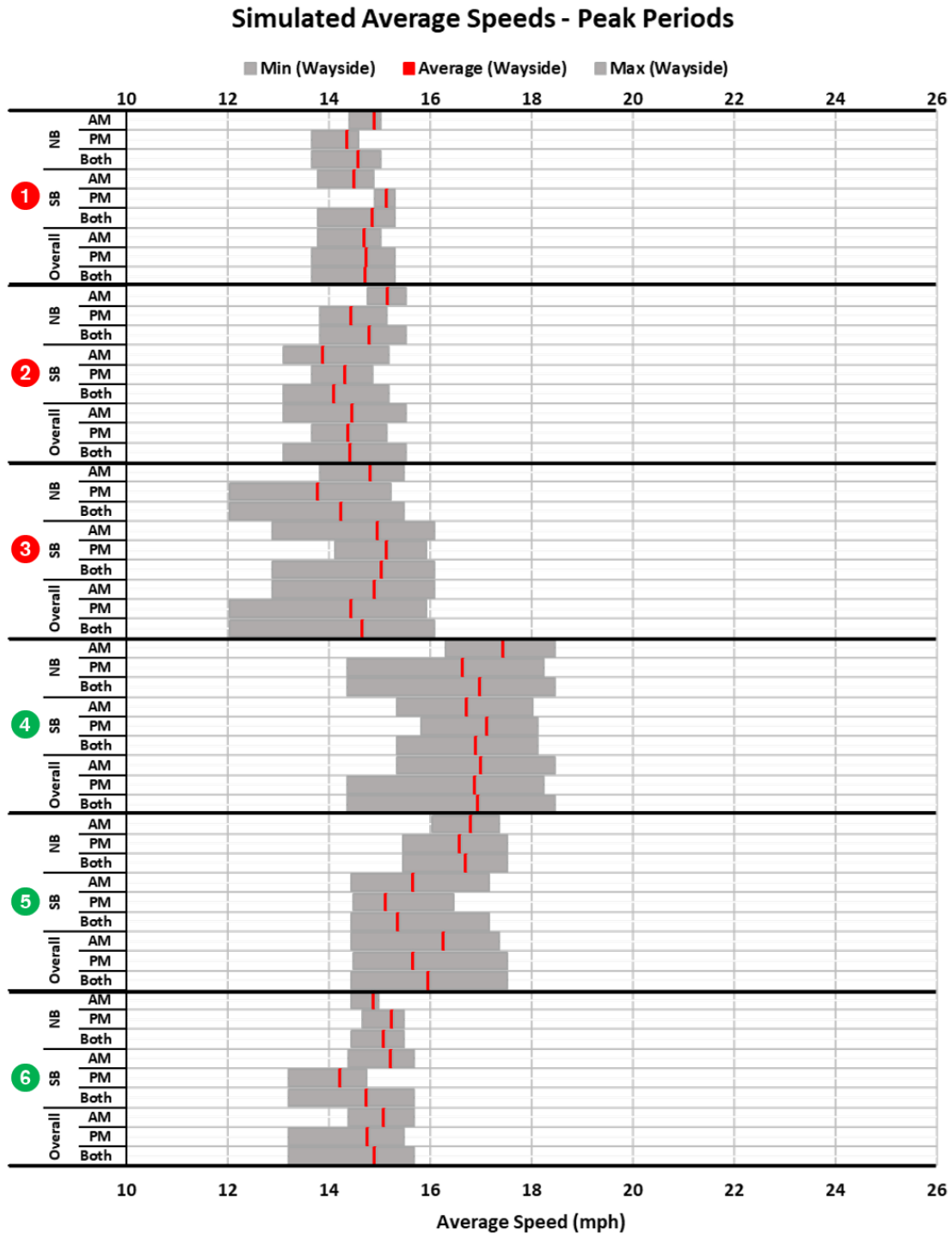
Line	Peak Period	Northbound			Southbound			Overall		
		Min	Max	Average	Min	Max	Average	Min	Max	Average
1	AM	0:58:14	1:00:46	0:58:43	0:58:50	1:03:32	1:00:21	0:58:14	1:03:32	0:59:33
	PM	1:00:00	1:04:04	1:00:54	0:57:15	0:58:47	0:57:47	0:57:15	1:04:04	0:59:23
	Both	0:58:14	1:04:04	1:00:00	0:57:15	1:03:32	0:58:54	0:57:15	1:04:04	0:59:27
2	AM	1:37:58	1:43:03	1:40:15	1:40:14	1:56:03	1:49:44	1:37:58	1:56:03	1:45:25
	PM	1:40:31	1:50:03	1:45:19	1:42:24	1:51:18	1:46:12	1:40:31	1:51:18	1:45:49
	Both	1:37:58	1:50:03	1:42:47	1:40:14	1:56:03	1:47:52	1:37:58	1:56:03	1:45:38
3	AM	1:10:17	1:18:40	1:13:27	1:07:46	1:24:38	1:13:03	1:07:46	1:24:38	1:13:13
	PM	1:11:27	1:30:22	1:19:15	1:08:24	1:17:10	1:12:00	1:08:24	1:30:22	1:15:46
	Both	1:10:17	1:30:22	1:16:44	1:07:46	1:24:38	1:12:33	1:07:46	1:30:22	1:14:33
4	AM	1:05:03	1:13:42	1:08:57	1:06:41	1:18:17	1:11:54	1:05:03	1:18:17	1:10:47
	PM	1:05:50	1:23:39	1:12:23	1:06:17	1:15:55	1:10:14	1:05:50	1:23:39	1:11:19
	Both	1:05:03	1:23:39	1:10:54	1:06:17	1:18:17	1:11:10	1:05:03	1:23:39	1:11:03
5	AM	1:23:30	1:30:27	1:26:23	1:24:29	1:40:22	1:32:48	1:23:30	1:40:22	1:29:22
	PM	1:22:46	1:33:50	1:27:36	1:28:07	1:40:12	1:36:01	1:22:46	1:40:12	1:32:54
	Both	1:22:46	1:33:50	1:26:52	1:24:29	1:40:22	1:34:37	1:22:46	1:40:22	1:31:06
6	AM	0:59:54	1:02:09	1:00:14	0:57:16	1:02:27	0:58:59	0:57:16	1:02:27	0:59:33
	PM	0:57:58	1:01:14	0:58:49	1:00:55	1:08:03	1:03:12	0:57:58	1:08:03	1:00:55
	Both	0:57:58	1:02:09	0:59:27	0:57:16	1:08:03	1:01:03	0:57:16	1:08:03	1:00:16

Figure B.3-2 shows minimum, maximum, and average speed by line by direction. Morning and evening peak period results are shown separately and as a combined set of peak period statistics. Results for each line only include trips making the regular stopping

BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

pattern from terminal to terminal and operating completely within the 6 a.m. to 10 a.m. or 3 p.m. to 7 p.m. time periods.

Figure B.3-2. Simulated Average Speed (mph) by time period, direction, time of day and line



BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

B.3.2 Terminal On-Time Performance

NYCT maintains a legacy statistic, terminal on-time performance, that measures lateness versus schedule. This is considered a legacy statistic because it does not measure the experience of most customers, who ride trains for middle segments of lines but do not actually use services to an end terminal. Trips that arrive early, precisely on schedule or no more than 5 minutes late are considered “on time.” Table B.3-2 displays A-Division terminal on-time performance by line including average reported on-time performance for the 12 months ending in November 2019.

Table B.3-2. A-Division Reported Terminal On-Time Performance by Line – Dec 2018 to Nov 2019

Subway Line	December 2018	January 2019	February 2019	March 2019	April 2019	May 2019	June 2019	July 2019	August 2019	September 2019	October 2019	November 2019	Average
1	78.0%	85.1%	83.6%	86.0%	87.1%	83.8%	82.6%	85.3%	88.2%	90.5%	86.0%	84.2%	85.0%
2	61.9%	72.4%	72.1%	72.0%	76.0%	73.6%	75.6%	71.0%	76.1%	78.2%	79.0%	81.2%	74.1%
3	74.0%	82.6%	85.2%	79.7%	85.9%	82.0%	81.9%	80.6%	85.8%	88.5%	88.9%	89.3%	83.7%
4	61.7%	66.0%	70.3%	73.9%	75.7%	74.0%	74.0%	74.4%	79.8%	76.1%	77.4%	76.6%	73.3%
5	70.1%	74.4%	75.8%	78.8%	81.4%	79.7%	81.5%	75.3%	81.8%	78.6%	80.7%	79.5%	78.1%
6	72.5%	72.2%	74.4%	75.5%	75.1%	76.2%	79.3%	80.9%	87.2%	78.5%	77.0%	77.5%	77.2%
S	99.8%	99.9%	99.8%	99.7%	99.8%	99.8%	99.9%	99.4%	99.5%	99.5%	98.3%	98.1%	99.5%
Average*	76.3%	80.7%	81.5%	82.3%	84.0%	82.7%	83.5%	83.0%	86.9%	84.9%	84.2%	84.1%	82.8%

Note: *MTA reports the Average On-Time Performance per month as the above. The straight mathematical average per month is lower. For example, in December 2018, MTA reports the average to be 76.3% but the straight mathematical average is 74.0%.

Table B.3-3 displays simulated on-time performance by line and by lateness threshold. The 5-minute lateness threshold is comparable to the NYCT-reported terminal on-time performance.

Table B.3-3. Simulated Terminal On-Time Performance by Line

Lateness Threshold	00:00:00		00:05:00		00:10:00		All Stops	
Subway Line	Trips	Pct (%)	Trips	Pct (%)	Trips	Pct (%)	Trips	Pct (%)
1	101	21.9%	427	92.4%	450	97.4%	462	100%
2	74	22.8%	263	81.2%	317	97.8%	324	100%
3	197	64.4%	285	93.1%	304	99.3%	306	100%
4	257	69.5%	339	91.6%	361	97.6%	370	100%
5	114	34.7%	306	93.0%	321	97.6%	329	100%
6	227	41.7%	493	90.6%	536	98.5%	544	100%
Combined	970	41.5%	2113	90.5%	2289	98.0%	2335	100%
Lateness Threshold	00:00:00		00:05:00		00:10:00		All Stops	
Subway Line	Trips	Pct (%)	Trips	Pct (%)	Trips	Pct (%)	Trips	Pct (%)
S	507	99.8%	508	100.0%	508	100.0%	508	100%

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Table B.3-4 compares simulated OTP with that reported in November 2019 and for the 12 months ending in November 2019. All lines exhibit higher OTP in the TrainOps® baseline model compared to the NYCT 12-month average.

Table B.3-4. Comparison of Terminal On-Time Performance by Line

Subway Line	Reported A-Division - November 2019	Reported A-Division - 12 Month Average	Simulated
1	84.2%	85.0%	92.4%
2	81.2%	74.1%	81.2%
3	89.3%	83.7%	93.1%
4	76.6%	73.3%	91.6%
5	79.5%	78.1%	93.0%
6	77.5%	77.2%	90.6%
S	98.1%	99.5%	100.0%
Average*	84.1%	82.8%	90.5%

Note: *MTA reports the Average On-Time Performance per month as the above. The straight mathematical average per month is lower.

B.3.3 Peak Service Delivery

Scheduled peak service delivery was derived from the NYCT operating plan and compared to the simulated peak service delivery at several key locations throughout the study area. Service delivery is measured in terms of trains passing in the peak 60 minutes during the morning and evening. Peak periods and service deliveries are only reported in this section if they fall completely within the 6 a.m. to 10 a.m. or 2 p.m. to 8 p.m. time periods. Comparing simulated versus scheduled operation is very useful in understanding where capacity-constrained operations prevent full scheduled service delivery.

BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

B.3.3.1 Nevins Street

Table B.3-5. Scheduled and Simulated Peak Hour Service Delivery – Nevins Street

Morning Peak Service Delivery				
			2 3 Line	4 5 Line
Northbound	Scheduled	TPH	19	23
		Peak Hour	8:40 – 9:40	8:08 – 9:08
	Simulated	TPH	20	24
		Peak Hour	8:59 – 9:59	8:09 – 9:09
Southbound	Scheduled	TPH	22	24
		Peak Hour	8:11 – 9:11	8:01 – 9:01
	Simulated	TPH	23	25
		Peak Hour	8:12 – 9:12	7:49 – 8:49
Evening Peak Service Delivery				
			2 3 Line	4 5 Line
Northbound	Scheduled	TPH	22	26
		Peak Hour	16:41 - 17:41	17:17 - 18:17
	Simulated	TPH	22	26
		Peak Hour	16:42 - 17:42	17:15 - 18:15
Southbound	Scheduled	TPH	19	25
		Peak Hour	16:51 - 17:51	16:44 - 17:44
	Simulated	TPH	20	26
		Peak Hour	17:02 - 18:02	16:45 - 17:45

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B.3.3.2 Grand Central - 42 Street

Table B.3-6. Scheduled and Simulated Peak Hour Service Delivery – Grand Central - 42 Street

Morning Peak Service Delivery				
			4 5 Line	6 Line
Northbound	Scheduled	TPH	25	19
		Peak Hour	8:31 – 9:31	8:26 – 9:26
	Simulated	TPH	26	20
		Peak Hour	8:28 – 9:28	8:35 – 9:35
Southbound	Scheduled	TPH	27	20
		Peak Hour	7:36 – 8:36	7:50 – 8:50
	Simulated	TPH	27	20
		Peak Hour	7:29 – 8:29	7:36 – 8:36
Evening Peak Service Delivery				
			4 5 Line	6 Line
Northbound	Scheduled	TPH	27	18
		Peak Hour	17:42 - 18:42	16:29 - 17:29
	Simulated	TPH	25	19
		Peak Hour	17:03 - 18:03	16:22 - 17:22
Southbound	Scheduled	TPH	26	18
		Peak Hour	15:46 – 16:46	15:41 - 16:41
	Simulated	TPH	27	19
		Peak Hour	16:18 - 17:18	15:48 – 16:48

BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

B.3.3.3 125 Street

Table B.3-7. Scheduled and Simulated Peak Hour Service Delivery – 125 Street

Morning Peak Service Delivery				
			④ ⑤ Line	⑥ Line
Northbound	Scheduled	TPH	25	19
		Peak Hour	8:43 – 9:43	8:42 – 9:42
	Simulated	TPH	24	20
		Peak Hour	8:47 – 9:47	8:51 – 9:51
Southbound	Scheduled	TPH	28	20
		Peak Hour	7:23 – 8:23	7:22 – 8:22
	Simulated	TPH	27	20
		Peak Hour	7:18 – 8:18	7:18 – 8:18
Evening Peak Service Delivery				
			④ ⑤ Line	⑥ Line
Northbound	Scheduled	TPH	27	18
		Peak Hour	17:55 - 18:55	16:47 - 17:47
	Simulated	TPH	23	19
		Peak Hour	16:46 - 17:46	16:40 - 17:40
Southbound	Scheduled	TPH	26	18
		Peak Hour	15:34 - 16:34	15:24 - 16:24
	Simulated	TPH	27	19
		Peak Hour	16:07 - 17:07	15:28 - 16:28

BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

B.3.3.4 Times Square - 42 Street

Table B.3-8. Scheduled and Simulated Peak Hour Service Delivery – Times Square - 42 Street

Morning Peak Service Delivery				
			① Line	② ③ Line
Northbound	Scheduled	TPH	19	19
		Peak Hour	8:52 – 9:52	8:55 – 9:55
	Simulated	TPH	18	18
		Peak Hour	8:32 – 9:32	7:56 – 8:56
Southbound	Scheduled	TPH	18	22
		Peak Hour	7:53 – 8:53	7:42 - 8:42
	Simulated	TPH	19	23
		Peak Hour	7:56 – 8:56	7:50 - 8:50
Evening Peak Service Delivery				
			① Line	② ③ Line
Northbound	Scheduled	TPH	16	22
		Peak Hour	17:14 - 18:14	17:12 - 18:12
	Simulated	TPH	16	22
		Peak Hour	17:05 - 18:05	17:05 - 18:05
Southbound	Scheduled	TPH	16	19
		Peak Hour	16:25 - 17:25	16:17 - 17:17
	Simulated	TPH	17	20
		Peak Hour	16:40 - 17:40	16:40 - 17:40

BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

B.3.3.5 96 Street

Table B.3-9. Scheduled and Simulated Peak Hour Service Delivery – 96 Street

Morning Peak Service Delivery				
			① Line	② ③ Line
Northbound	Scheduled	TPH	18	18
		Peak Hour	8:47 – 9:47	8:19 – 9:19
	Simulated	TPH	18	19
		Peak Hour	8:44 – 9:44	8:47 – 9:47
Southbound	Scheduled	TPH	18	23
		Peak Hour	7:41 – 8:41	7:34 – 8:34
	Simulated	TPH	19	23
		Peak Hour	7:43 – 8:43	7:40 – 8:40
Evening Peak Service Delivery				
			① Line	② ③ Line
Northbound	Scheduled	TPH	17	22
		Peak Hour	17:57 - 18:57	17:20 - 18:20
	Simulated	TPH	16	22
		Peak Hour	17:18 - 18:18	17:16 - 18:16
Southbound	Scheduled	TPH	16	19
		Peak Hour	16:14 - 17:14	16:09 - 17:09
	Simulated	TPH	17	20
		Peak Hour	16:28 - 17:28	16:32 - 17:32

BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

B.3.3.6 231 Street

Table B.3-10. Scheduled and Simulated Peak Hour Service Delivery – 231 Street

Morning Peak Service Delivery			
			① Line
Northbound	Scheduled	TPH	12
		Peak Hour	8:58 – 9:58
	Simulated	TPH	12
		Peak Hour	9:00 – 10:00
Southbound	Scheduled	TPH	16
		Peak Hour	7:07 – 8:07
	Simulated	TPH	17
		Peak Hour	7:18 - 8:18
Evening Peak Service Delivery			
			① Line
Northbound	Scheduled	TPH	17
		Peak Hour	18:21 – 19:21
	Simulated	TPH	16
		Peak Hour	17:43 – 18:43
Southbound	Scheduled	TPH	16
		Peak Hour	15:50 - 16:50
	Simulated	TPH	17
		Peak Hour	16:04 – 17:04

BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

B.3.3.7 145 Street

Table B.3-11. Scheduled and Simulated Peak Hour Service Delivery – 145 Street

Morning Peak Service Delivery			
			3 Line
Northbound	Scheduled	TPH	8
		Peak Hour	7:53 – 8:53
	Simulated	TPH	10
		Peak Hour	8:23 - 9:23
Southbound	Scheduled	TPH	12
		Peak Hour	7:22 - 8:22
	Simulated	TPH	12
		Peak Hour	7:24 – 8:24
Evening Peak Service Delivery			
			3 Line
Northbound	Scheduled	TPH	12
		Peak Hour	17:44 - 18:44
	Simulated	TPH	12
		Peak Hour	18:13 - 19:13
Southbound	Scheduled	TPH	9
		Peak Hour	14:56 – 15:56
	Simulated	TPH	9
		Peak Hour	14:56 – 15:56

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B.3.3.8 Baychester Avenue

Table B.3-12. Scheduled and Simulated Peak Hour Service Delivery – Baychester Avenue

Morning Peak Service Delivery			
			5 Line
Northbound	Scheduled	TPH	8
		Peak Hour	8:59 – 9:59
	Simulated	TPH	8
		Peak Hour	8:23 - 9:23
Southbound	Scheduled	TPH	8
		Peak Hour	7:08 – 8:08
	Simulated	TPH	8
		Peak Hour	7:09 – 8:09
Evening Peak Service Delivery			
			5 Line
Northbound	Scheduled	TPH	9
		Peak Hour	15:57 - 16:57
	Simulated	TPH	9
		Peak Hour	16:02 – 17:02
Southbound	Scheduled	TPH	11
		Peak Hour	14:57 - 15:57
	Simulated	TPH	11
		Peak Hour	14:49 - 15:49

BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

B.3.3.9 Hunts Point Avenue

Table B.3-13. Scheduled and Simulated Peak Hour Service Delivery – Hunts Point Avenue

Morning Peak Service Delivery			
			6 Line
Northbound	Scheduled	TPH	17
		Peak Hour	8:58 – 9:58
	Simulated	TPH	17
		Peak Hour	8:58 – 9:58
Southbound	Scheduled	TPH	21
		Peak Hour	7:12 - 8:12
	Simulated	TPH	21
		Peak Hour	7:18 - 8:18
Evening Peak Service Delivery			
			6 Line
Northbound	Scheduled	TPH	19
		Peak Hour	17:15 – 18:15
	Simulated	TPH	20
		Peak Hour	17:15 - 18:15
Southbound	Scheduled	TPH	18
		Peak Hour	15:12 - 16:12
	Simulated	TPH	19
		Peak Hour	15:15 - 16:15

B.3.4 Capacity and Peak Service Delivery

Capacity is the total number of trains per hour the line can support. This is calculated by using minimum supportable headway. Capacity in trains per hour equals one hour (60 minutes) divided by the headway, defined in minutes and fractions thereof.

Minimum supportable headway can be based on Proceed (green) or Caution (yellow) aspects. Using known minimum supportable headways from capacity-constrained segments (Lexington Avenue Line), using Caution (yellow) aspect headways provides the best prediction of NYCT line capacity. A small factor must be added to headway to account for Train Operator signal preview time and operating variability.

Table F.5-1 and Table F.5-2 show the theoretical trains per hour at each station, in the morning and evening peak periods respectively, calculated using the calibrated Phase I-IV model in TrainOps®. These numbers were used to create the base layer showing the capacity in Figure B.3-3 and Figure B.3-4. In some segments, especially those with short station dwell times, localized TPH capacity computations may yield a value higher than 30 trains per hour. However, all segment-specific capacities have been capped at 30 trains per hour given overall system capacity limits.

The NYCT operating plan was used as the basis for calibration.

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Detailed morning and evening peak service capacity for all station-station pairs throughout the network is provided in Section F.4.

Peak period service delivery is represented by colored lines corresponding to each of the services (volumes associated with 2 Line and 3 Line trains are combined when operating on the same tracks in Manhattan as are the 4 Line and 5 Line trains), while available line and terminal capacity is represented by black lines.

Thicker black lines correspond to territories with higher capacity. In segments where colored lines fully cover the underlying black lines, there is no available capacity. Gray boxes separate regions where localized track capacity changes; within each box, capacity presented in the graphic is constant. Yellow shading of tracks highlights severely capacity-constrained locations discussed in this report. Southbound and northbound line thicknesses do not necessarily match, as they reflect the peak hour operation for each line and direction. Therefore, southbound and northbound peak hour service levels may be different as shown in Figure B.3-3 for the morning peak period and in Figure B.3-4 for the evening peak period.

Available capacity in one segment may not be utilizable if the line is capacity-constrained at other points in the network. It should also be noted that some track segments with available capacity may not have enough passenger demand to justify increasing service even if unconstrained by line capacity constraints in other segments.

The capacities of the terminals are based on terminal microsimulations developed using the TrainOps® database of the A-Division network. These analyses are conducted by simulated batches of trains at a set initial aggressive headway from a station approaching to the terminal to the terminal itself and then return. Simulations are based on full-length trains of the type that normally uses the terminal under analysis with the same schedule margin as is used in the calibrated network simulation.

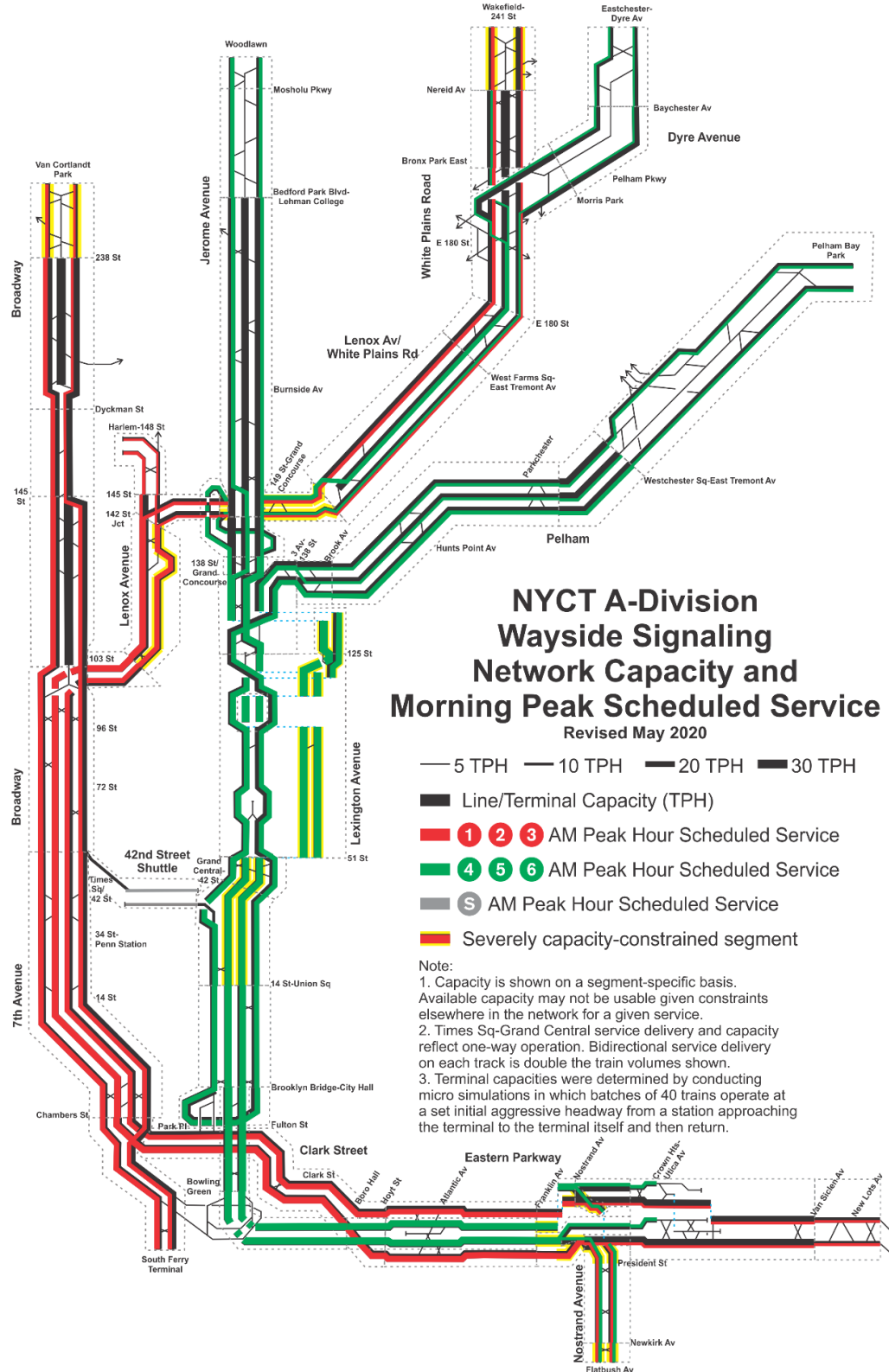
In an iterative process, the initial aggressive headway for each successive batch is relaxed until a minimum achievable (“steady state”) headway is reached. The reported result, in terminal trains per hour, reflects a 10 percent derating factor from the microsimulation theoretical result to the reported practical result, providing a small margin for Train Operator and dwell time variability. As an example, a theoretical microsimulation result of 20 TPH is derated by multiplying the result by 0.9 and obtaining a practical terminal capacity of 18 TPH.

At terminals supported by nearby yards (including Westchester Yard’s support of Pelham Bay Park), the terminal microsimulations assume a 50/50 split of trains entering service from the yard and turns from previous revenue trips in the morning peak period. In the evening, the terminal microsimulations assume a 50/50 split of trains leaving service to the yard and turns from previous revenue trips. At Flatbush Avenue - Brooklyn College, the terminal microsimulations assume continued segregation of the 2 Line and 5 Line trains by track.

All terminal microsimulations use the standard network simulation values of 5 seconds for interlocking route release time and 12 seconds for interlocking route establishment time for the next arriving train. All terminal microsimulations use the standard 90-second minimum turn time that is based on the use of dropback crews.

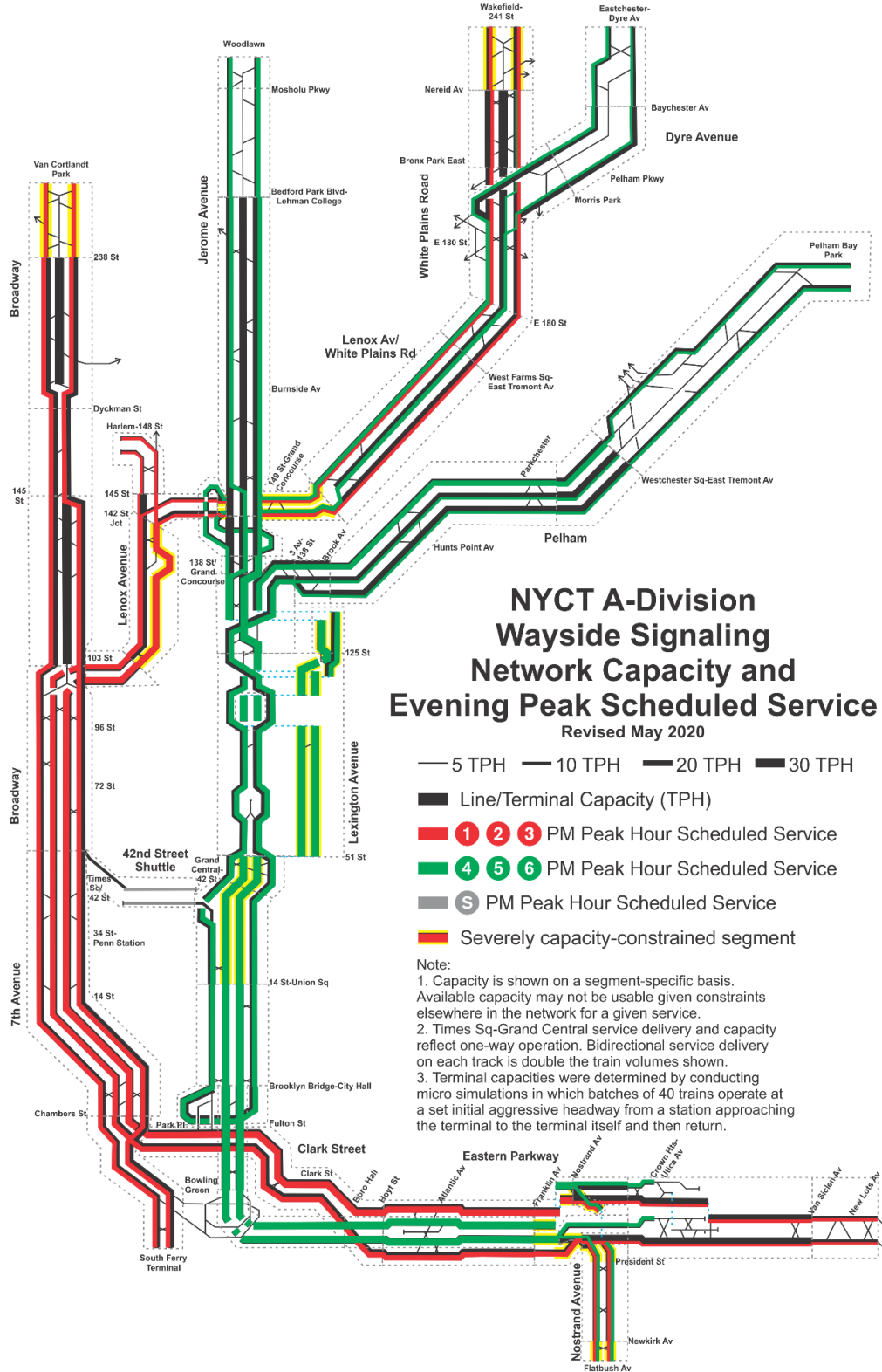
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Figure B.3-3. Network Capacity and Morning Peak Scheduled Service



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Figure B.3-4. Network Capacity and Evening Peak Scheduled Service



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B.3.5 Simulated Congestion Locations

Simulated congestion can be highlighted geographically by presenting length of signal delay per trip in each segment of the A-Division simulation. A secondary measure, presented in Section B.3.5.2, is the number of times that Station Time (ST) cutbacks are invoked in the simulation in each segment. The use of ST cutbacks reflects a train closing in on a train ahead at reduced speed. Comparison of ST cutback usage per segment can be misleading as not all segments have the same number of ST-equipped signals (in fact, some segments have none at all).

B.3.5.1 Signal Delay

For the purpose of presenting signal delay graphically, a segment is defined as station-to-station. The STV Team computed simulated signal delay (in seconds) per trip, further dividing the statistics into East Side and West Side A-Division services.

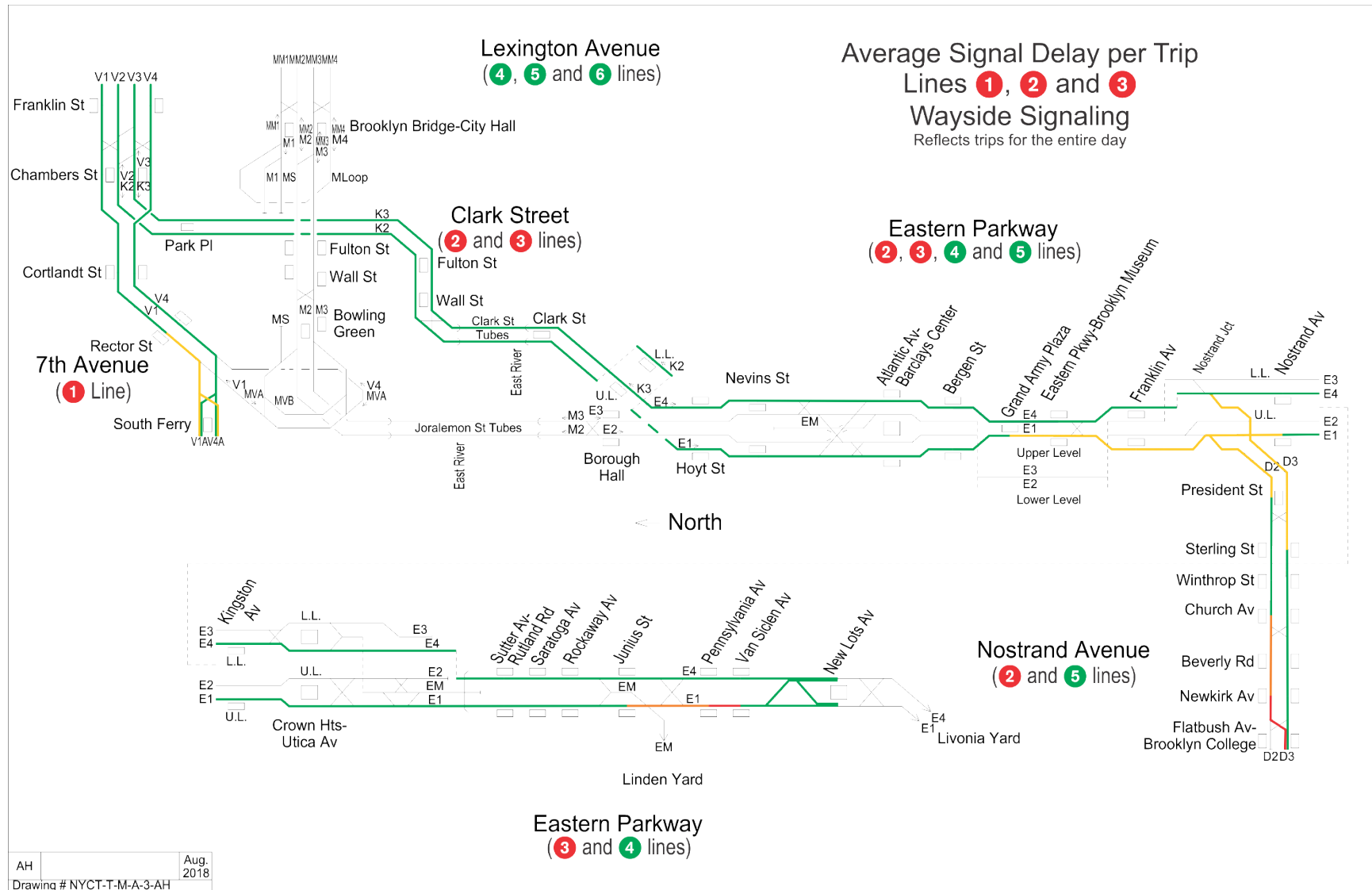
The figures use the following color conventions:

- Green: 0 to 10 seconds of signal delay per trip per segment
- Yellow: 11 to 30 seconds of signal delay per trip per segment
- Orange: 31 to 49 seconds of signal delay per trip per segment
- Red: 50 or more seconds of signal delay per trip per segment

Orange segments reflect significant congestion and red segments reflect severe congestion. Red segments should be targeted for mitigation through infrastructure and/or operating plan changes.

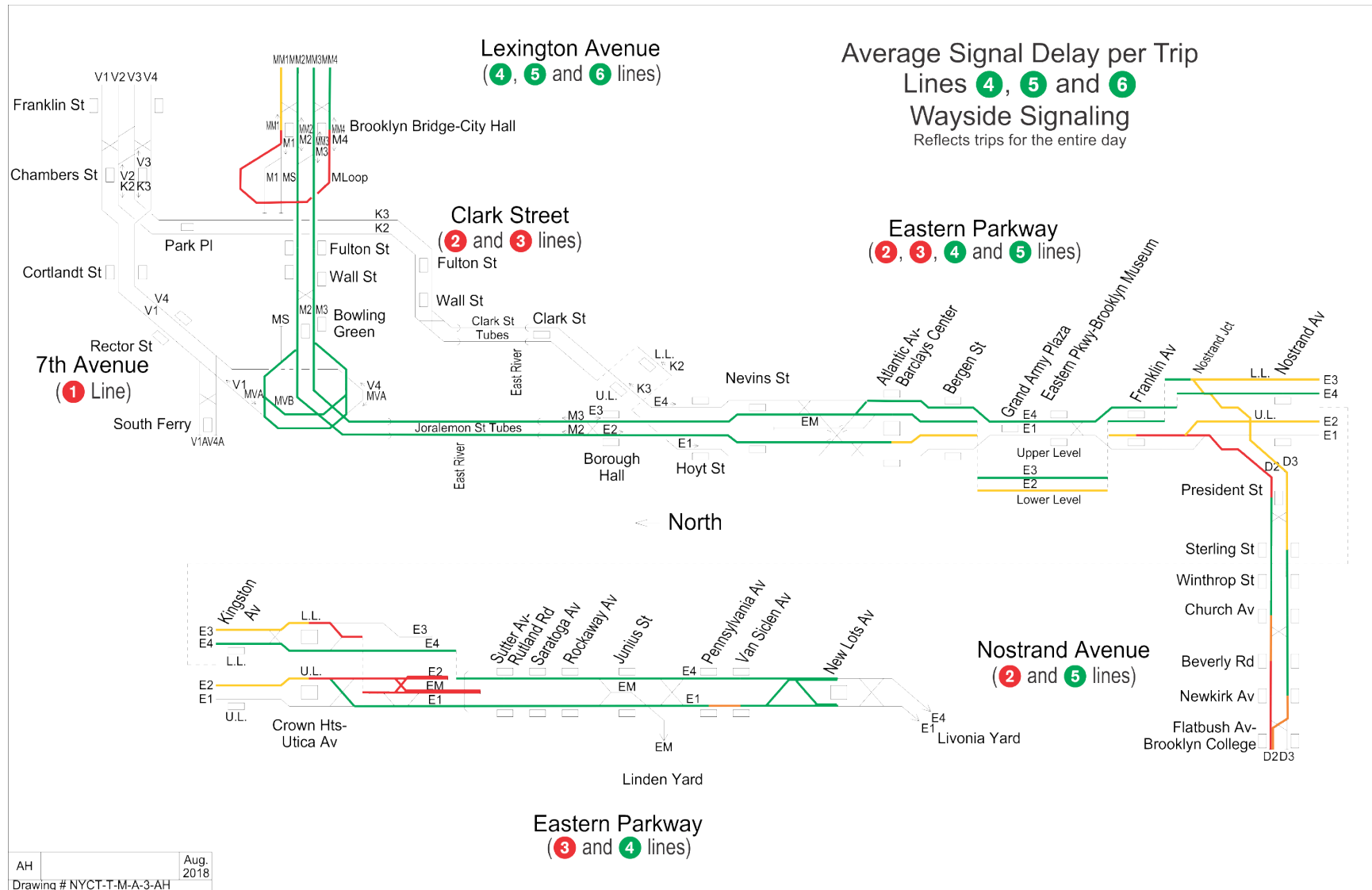
BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure B.3-5. Phase I schematic highlighting signal delay for the 1, 2 and 3 Lines



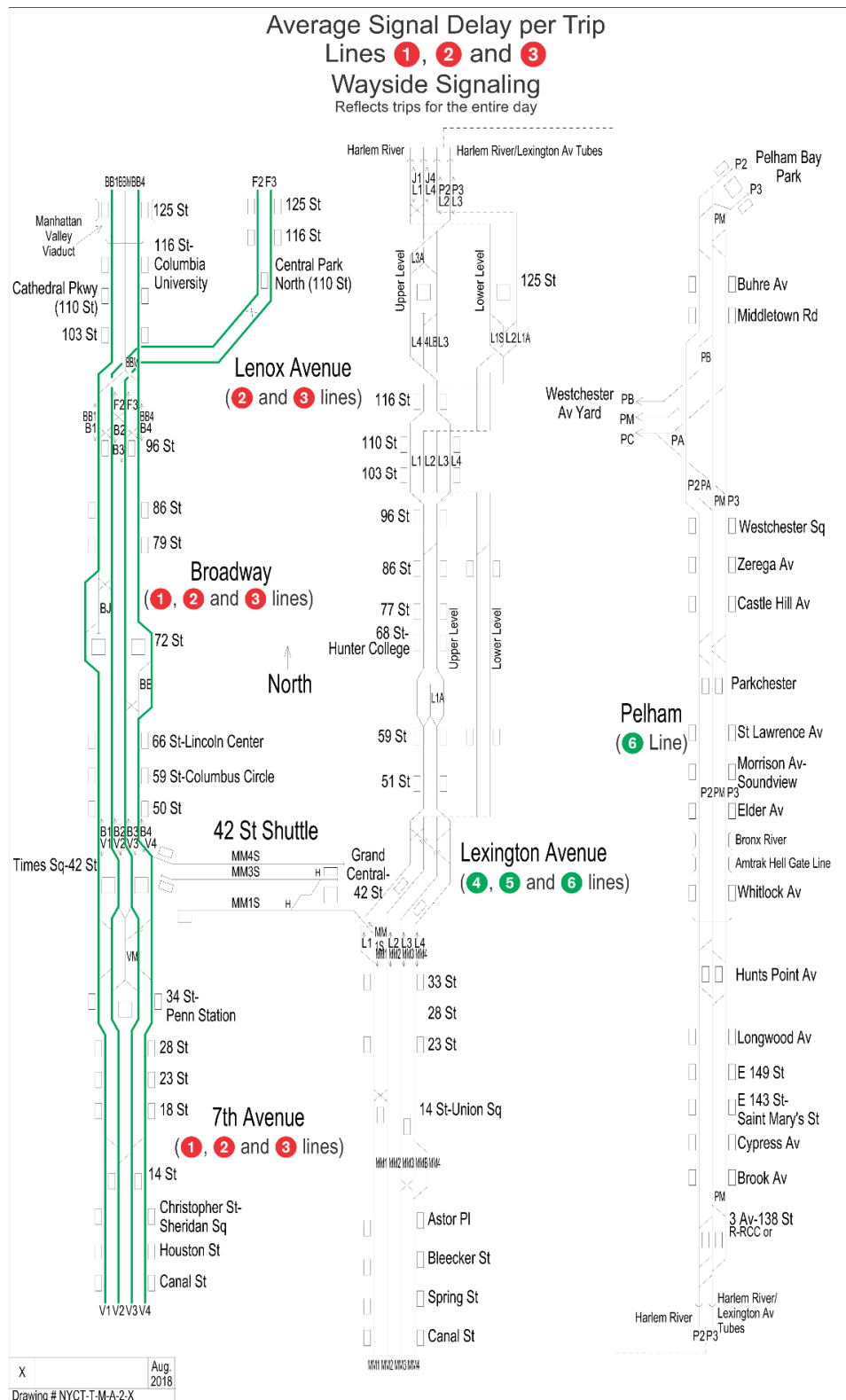
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Figure B.3-6: Phase I schematic highlighting signal delay for the 4, 5 and 6 Lines



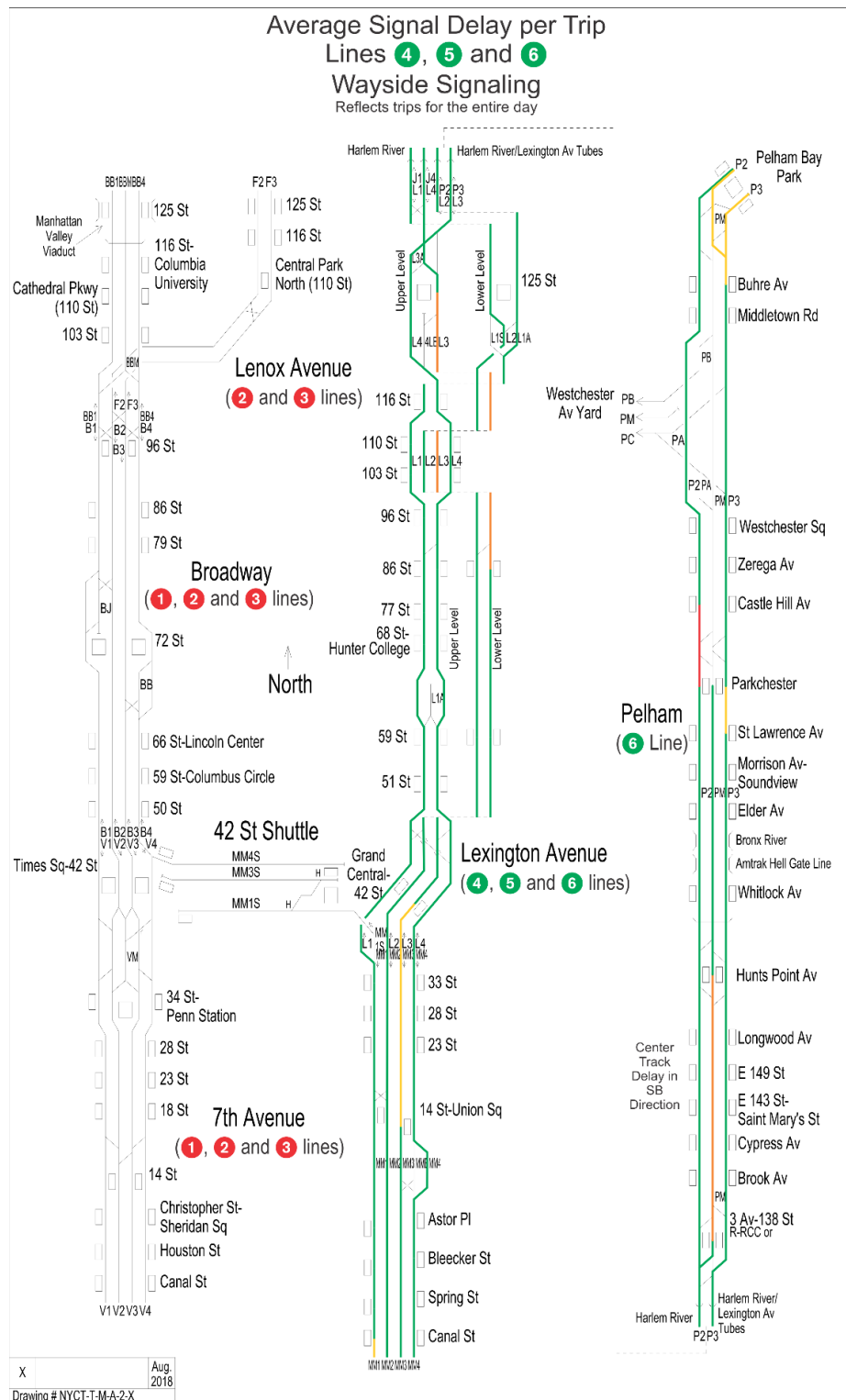
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Figure B.3-7: Phase II, III & IV schematic highlighting signal delay for the 1, 2 and 3 Lines



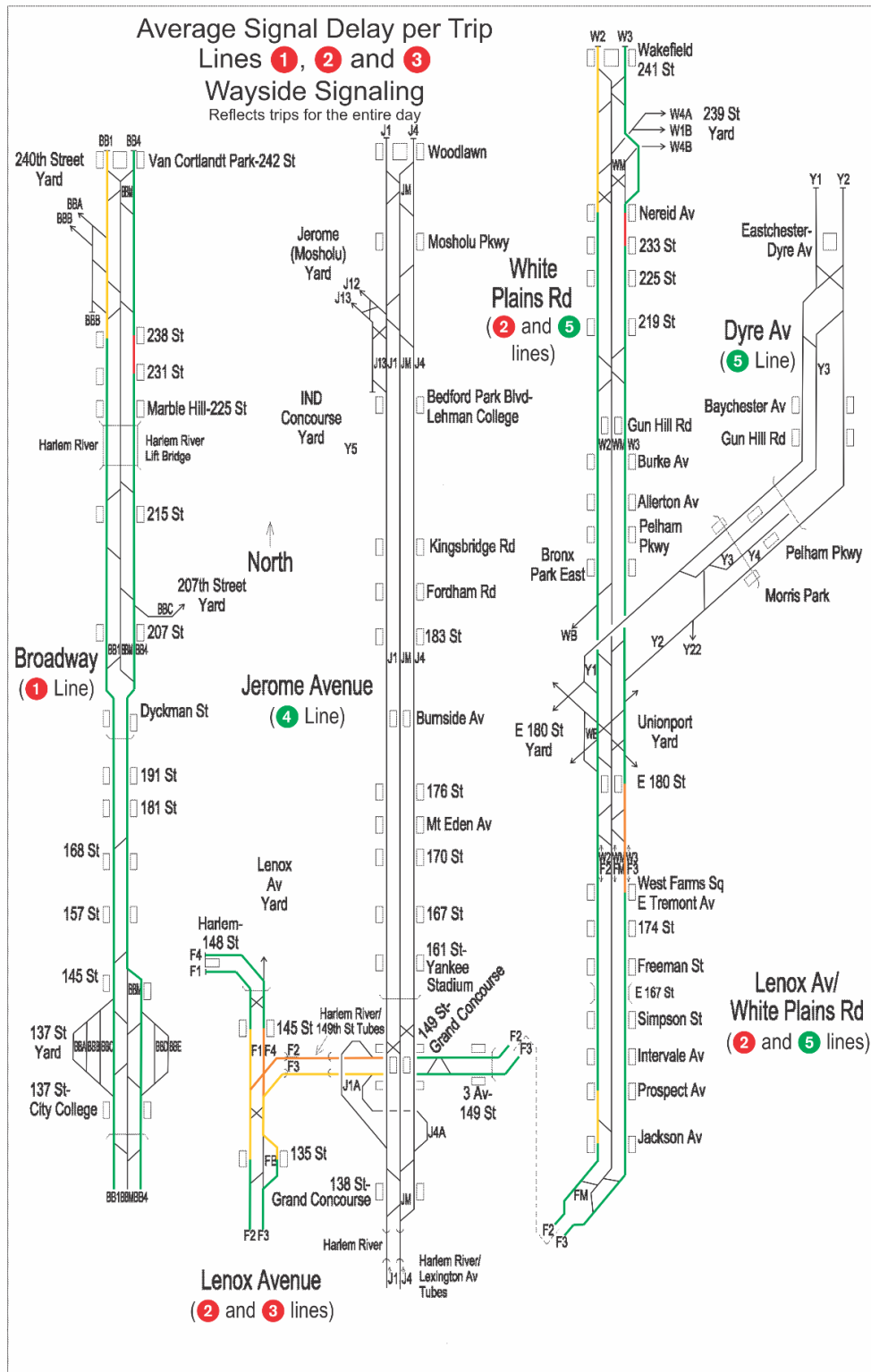
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Figure B.3-8: Phase II, III & IV schematic highlighting signal delay for the 4, 5 and 6 Lines



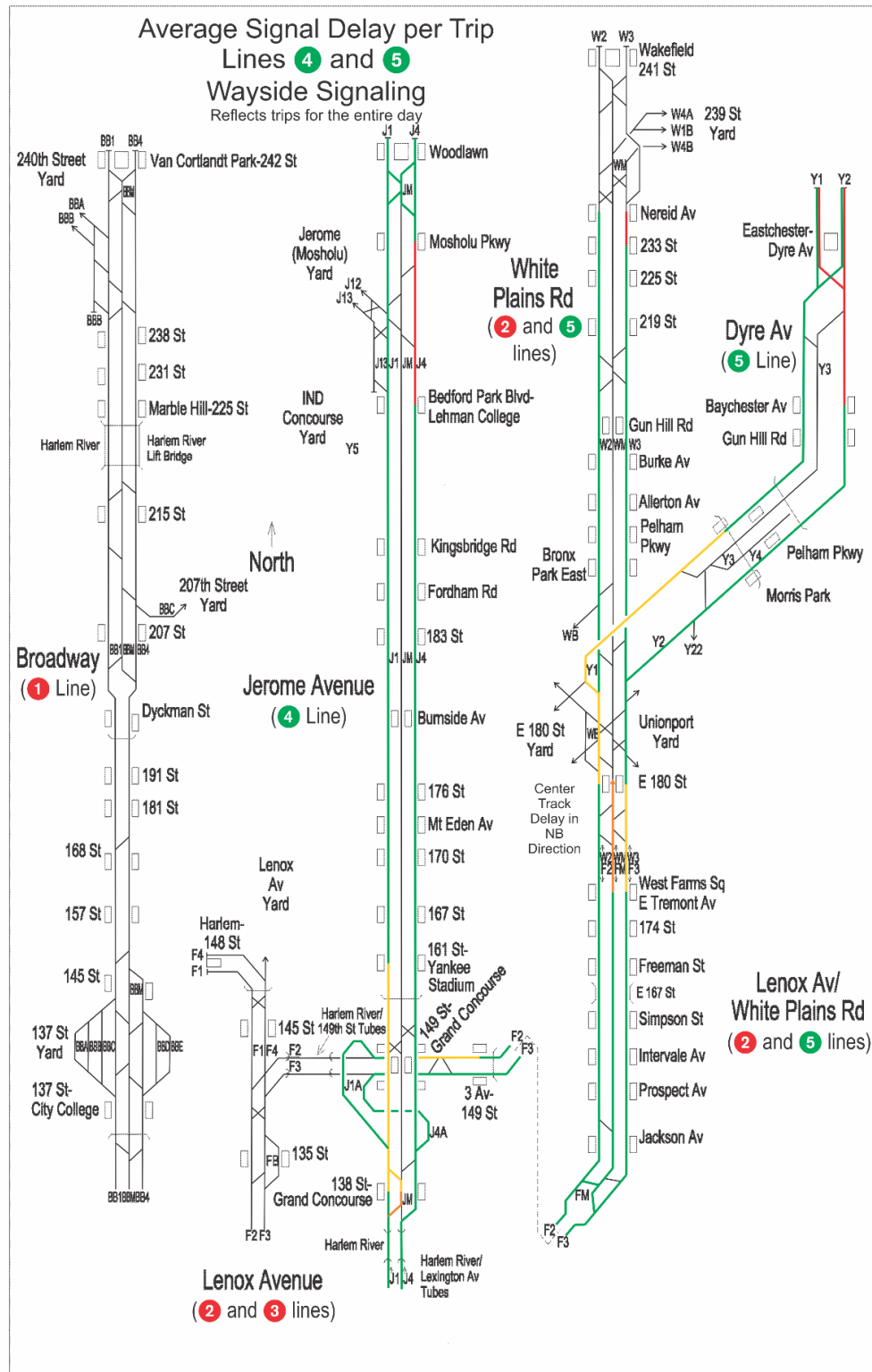
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Figure B.3-9: Phase IV schematic highlighting signal delay for 1, 2 and 3 Lines



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Figure B.3-10: Phase IV schematic highlighting signal delay for the 4 and 5 Lines



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Figure B.3-5, Figure B.3-6, Figure B.3-7, Figure B.3-8, Figure B.3-9, and Figure B.3-10 highlight many of the well-known A-Division capacity constraints. The approaches to the flat junctions at Brooklyn's Nostrand Junction and Manhattan's 142 Street Junction show as prominent congestion locations. The approaches to all A-Division terminals show at least one segment of orange (significant) or red (severe) congestion except South Ferry and Pelham Bay Park, both of which show yellow (moderate) congestion. The merge of the southbound 4 Line and 5 Line trains at 138 St-Grand Concourse and the southbound morning merge of the 6 Line local and express trains at 3 Av-138 St also show in the figures as congested locations.

B.3.5.2 Station Time Signal Control Line Cutback Events

This measure reflects the percentage of potential times that Station Time (ST) cutbacks are invoked in the simulation in each segment. The use of ST cutbacks reflects a train closing in on a train ahead at reduced speed, thereby highlighting congestion locations. Detailed ST cutback usage statistics for northbound and southbound operations are included in Section B.3.5.2. The number of opportunities for ST cutbacks reflects 24-hour weekday operations.

B.3.6 Time-Distance String Charts

Time-distance string charts, shown in Section F.3, were generated from the simulation results for the morning and evening peak periods, distinguishing northbound and southbound trips on separate charts. Because of the complexity of the NYCT network, the tracks are separated into the following geographic territories:

- 138 Street - Grand Concourse to Brooklyn Bridge;
- Brooklyn Bridge to Nevins Street;
- Nevins Street to New Lots Avenue;
- Nevins Street to Flatbush Avenue -Brooklyn College;
- Pelham Bay Park to 3 Avenue - 138 Street;
- Wakefield - 241 Street to 138 Street - Grand Concourse;
- Eastchester - Dyre Avenue to 138 Street - Grand Concourse;
- Woodlawn to 138 Street - Grand Concourse;
- Harlem - 148 Street to Nevins Street; and
- Van Cortlandt Park - 242 Street to 96 Street.

In all cases, the geographic territory is shown on the vertical axis with north at the top and south at the bottom. Trip plots ("strings") are shown heading up and to the right for northbound trips and heading down and to the right for southbound trips.

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For all geographic territories, the ① Line is shown in light red, the ② and ③ Lines are shown in red, the ④ and ⑤ Lines are shown in green, and the ⑥ Line is shown in dark grey. The ① and ⑥ Lines are shown in different colors so that they can be distinguished from the trips running on the express tracks of their respective lines.

The string charts reflect morning peak periods from 6 a.m. to 10 a.m. and evening peak periods from 3 p.m. to 7 p.m. The individual strings are labeled with the simulated trip ID that is constructed from information in the NYCT RTIF files:

- Service,
- Initial terminal departure time,
- Run number,
- Direction (“N” or “S”).

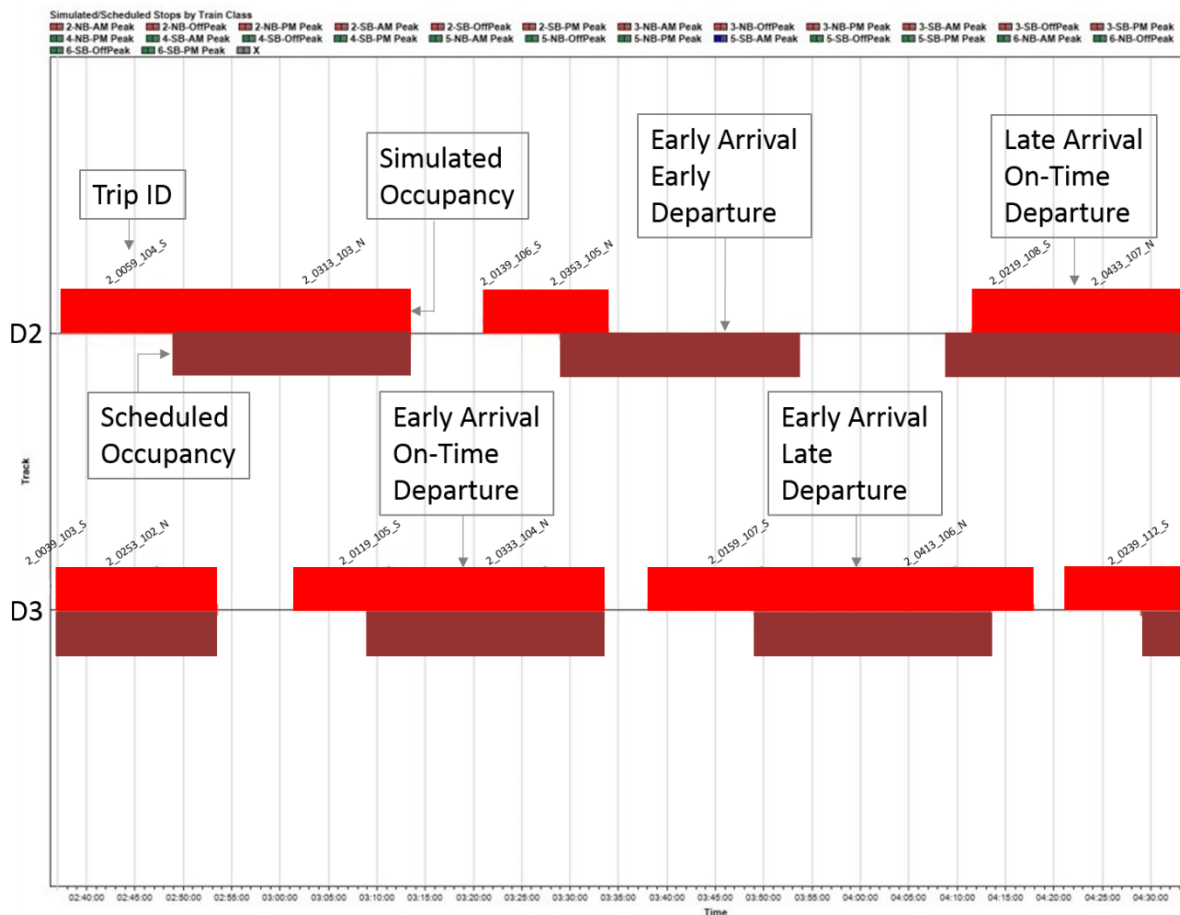
While horizontal lines generally represent station stops, horizontal lines outside of station locations reflect simulated delays. This can be observed at Bowling Green, for example, where northbound ④ Line trips are held south of the station for ⑤ Line trips using the Battery Park Loop and requesting a route first.

B.3.7 Terminal Station Occupancy Charts

Terminal station occupancy charts are useful in assessing how congested terminals are, determining whether any late dispatches occurred in simulation and evaluating whether the simulated minimum required terminal dwell is sufficiently short to allow for recovery from lateness. As shown in Figure B.3-5, the TrainOps® station occupancy charts show scheduled station occupancy below the reference line corresponding to each station track and actual (simulated) occupancy above the line.

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Figure B.3-5. Example of TrainOps® Station Occupancy Chart



Terminal occupancy charts are shown in Section F.4. The occupancies are color-coded using the NYCT standard colors for East Side and West Side A-Division services, with schedule and simulated occupancies shown in slightly different shades. Non-revenue trips such as the X5_0516_249 trip from New Lots Avenue to Flatbush Avenue - Brooklyn College are shown in gray, rather than the red or green revenue service color. Other non-revenue relay or loop moves are also shown in gray, such as the 6 service at Brooklyn Bridge – City Hall and the 4 service at Crown Heights - Utica Avenue.

All trains on the 1 2 3 4 5 6 Lines are assumed to be 10 cars (510 feet) long and berthing is always at the end of platform in the modeling. Intermediate car stop markers are not considered.



IRT CAPACITY STUDY

1 2 3 4 5 6 S LINES

C - FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM



Prepared for:



by:
STV

Document Number: LTK.C4855.05.01

June 2020

FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

C.0 Revision History – This Section

Revision No.	Date	Description of Revision
0	August 5, 2019	Initial Release
1	August 28, 2019	Clarified future status of R142/R142A fleet under CBTC operation. Added New Lots Avenue terminal analysis
2	May 4, 2020	Updated to reflect full Phase I-IV simulation results
3	June 15, 2020	Updated to incorporate NYCT review comments
4	July 31, 2020	Final Release

FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

C.1 Introduction

For the introduction to this study, including a description of the study area and phases, and study methodology, refer to Part A of this report.

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C.2 Summary

This Technical Memorandum details the A-Division full-network (Phases I-IV) future baseline simulation results with Communications-Based Train Control (CBTC) in service on all lines, using the TrainOps® software developed by LTK. The results for the future baseline simulation are compared with the existing baseline simulation results. The future baseline operating plan increases scheduled service on the A-Division East Side and West Side Lines during peak periods versus the existing baseline. Outside of peak periods, the future baseline operating plan maintains existing levels of service; this service planning strategy maximizes yard put-ins and lay-ups, testing the A-Division terminals' abilities to manage service ramp-ups and ramp-downs with CBTC. For CBTC operating plans refer to Section G.2.

C.2.1 Average Speed and On-Time Performance Comparison – Wayside versus CBTC

The future baseline operating plan includes a peak service level of 30 TPH on the 1 Line, 6 Line, and combined 4 and 5 Lines. On the combined 2 and 3 Lines, a peak service level of 26 TPH is scheduled due to concerns about capacity constraints at Nostrand Junction. The split of 4 Line and 5 Line service in the peak is heavily weighted in favor of the 4 Line to manage the conflicts at Nostrand Junction. A total of 35 TPH, including 2 Line, 3 Line and 5 Line services, is scheduled to operate through a common Nostrand Junction track segment in each direction in peak periods.

Future Baseline simulation results show significant improvements in travel time, line capacity, and terminal capacity over the existing wayside signaling operation. The existing baseline simulation results are presented in Part B of this report, including database development and calibration effort for existing NYCT operations.

Figure C.2-1 shows minimum, maximum and average speed by line by direction, with the Existing Baseline results shown in gray and the Future Baseline (CBTC) results in blue. Morning and evening peak period results are shown separately and as a combined set of peak period statistics. Only trips operating entirely within the 6 a.m. to 10 a.m. or 3 p.m. to 7 p.m. time periods are reflected. As would be expected, the 2, 3, 4, and 5 Lines show the highest average speeds as the services operate express in Manhattan. The 1 and 6 Lines show lower average speeds as the services operate local in Manhattan.

Comparing the Future Baseline (CBTC) results with the existing wayside simulation, all lines show significant improvement in average travel time. This is due to the significant number of curve-related speed restrictions that are improved under CBTC and the ability of all A-Division trains to operate with CBTC acceleration rather than the lower wayside signaling acceleration.

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Figure C.2-1: Average Speed (mph) Comparison by time period, direction, time of day and line

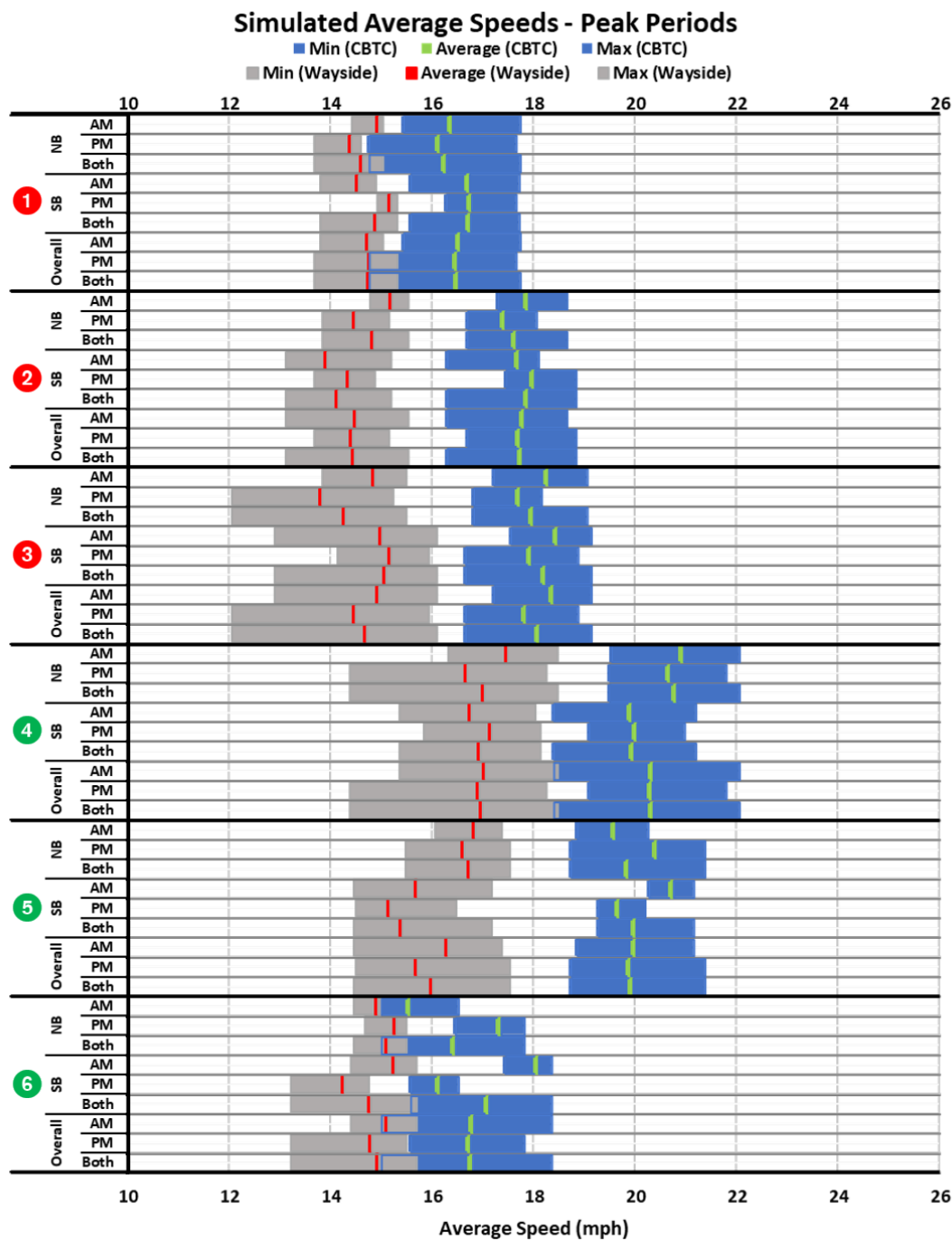


Table C.2-1 shows simulated on-time performance (OTP) for existing wayside operation by line and by lateness threshold. The 5-minute lateness threshold is comparable to the NYCT-reported end terminal on-time performance.

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**Table C.2-1. Simulated Terminal On-Time Performance by Line –
Existing Baseline (Wayside)**

Lateness Threshold	00:00:00		00:05:00		00:10:00		All Stops	
Subway Line	Trips	Pct (%)	Trips	Pct (%)	Trips	Pct (%)	Trips	Pct (%)
1	101	21.9%	427	92.4%	450	97.4%	462	100%
2	74	22.8%	263	81.2%	317	97.8%	324	100%
3	197	64.4%	285	93.1%	304	99.3%	306	100%
4	257	69.5%	339	91.6%	361	97.6%	370	100%
5	114	34.7%	306	93.0%	321	97.6%	329	100%
6	227	41.7%	493	90.6%	536	98.5%	544	100%
Combined	970	41.5%	2,113	90.5%	2,289	98.0%	2,335	100%
S	507	99.8%	508	100.0%	508	100.0%	508	100%

Table C.2-2 shows Future Baseline (CBTC) on-time performance for each line for three different end terminal lateness thresholds. Using a five-minute lateness threshold, the overall simulation shows a 94.8 percent OTP. This reflects tighter (shorter) scheduled run times so the improvement is even more significant than the 94.8 percent (Table C.2-2) versus 90.5 percent (Table C.2-1) simulated OTP gain.

Although 3 Line on-time performance appears to decrease from 93.1 percent under wayside operation to 90.8 percent under CBTC operation, several differences between the wayside and CBTC simulation models such as shorter run times and higher scheduled/simulated service delivery prevent a direct comparison.

**Table C.2-2. Simulated Terminal On-Time Performance by Line –
Future Baseline (CBTC)**

NOTE: Not comparable to Existing Baseline OTP. Assumes shorter scheduled CBTC run times.

Lateness Threshold	00:00:00		00:05:00		00:10:00		All Stops	
Subway Line	Trips	Pct (%)	Trips	Pct (%)	Trips	Pct (%)	Trips	Pct (%)
1	149	23.2%	597	93.0%	641	99.8%	642	100%
2	91	25.0%	341	93.7%	361	99.2%	364	100%
3	66	19.6%	306	90.8%	336	100%	337	100%
4	236	53.0%	438	98.4%	445	100%	445	100%
5	194	64.9%	282	94.3%	298	100%	299	100%
6	393	61.0%	626	97.2%	640	99.4%	644	100%
Combined	1,129	41.3%	2,590	94.8%	2,721	99.6%	2,731	100%
S	282	50.0%	564	100.0%	564	100.0%	564	100%

C.2.2 Peak Service Delivery and Overall Network Capacity

Simulated peak service delivery (throughput) for both existing baseline (wayside signaling) and Scheduled peak service delivery was derived from the NYCT operating plan and compared to the simulated wayside and CBTC peak service delivery at several key locations. Comparing simulated versus scheduled operation is very useful in understanding where capacity-constrained operations prevent full scheduled service delivery. Comparing peak service delivery for wayside

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signaling versus CBTC is also useful though the underlying simulated operating plans (scheduled TPH) are different.

The TrainOps® simulation results were used to calculate the theoretical trains per hour across all services and tracks in the study area. The analysis was then used to develop overall network capacity graphics. The morning peak period is shown in Figure C.2-2 (Wayside) and Figure C.2-3 (CBTC) while the evening peak period is shown in Figure C.2-4 (Wayside) and Figure C.2-5 (CBTC).

The overall CBTC network capacity graphics are further discussed in Section C.3 and reflect the operating plan and service levels described in paragraph C.3.3. Detailed morning and evening peak service capacity for all station-station pairs throughout the network is provided in tabular form in Section G.4. Detailed peak service capacity for the wayside network capacity graphics is provided in tabular form in Section G.3.

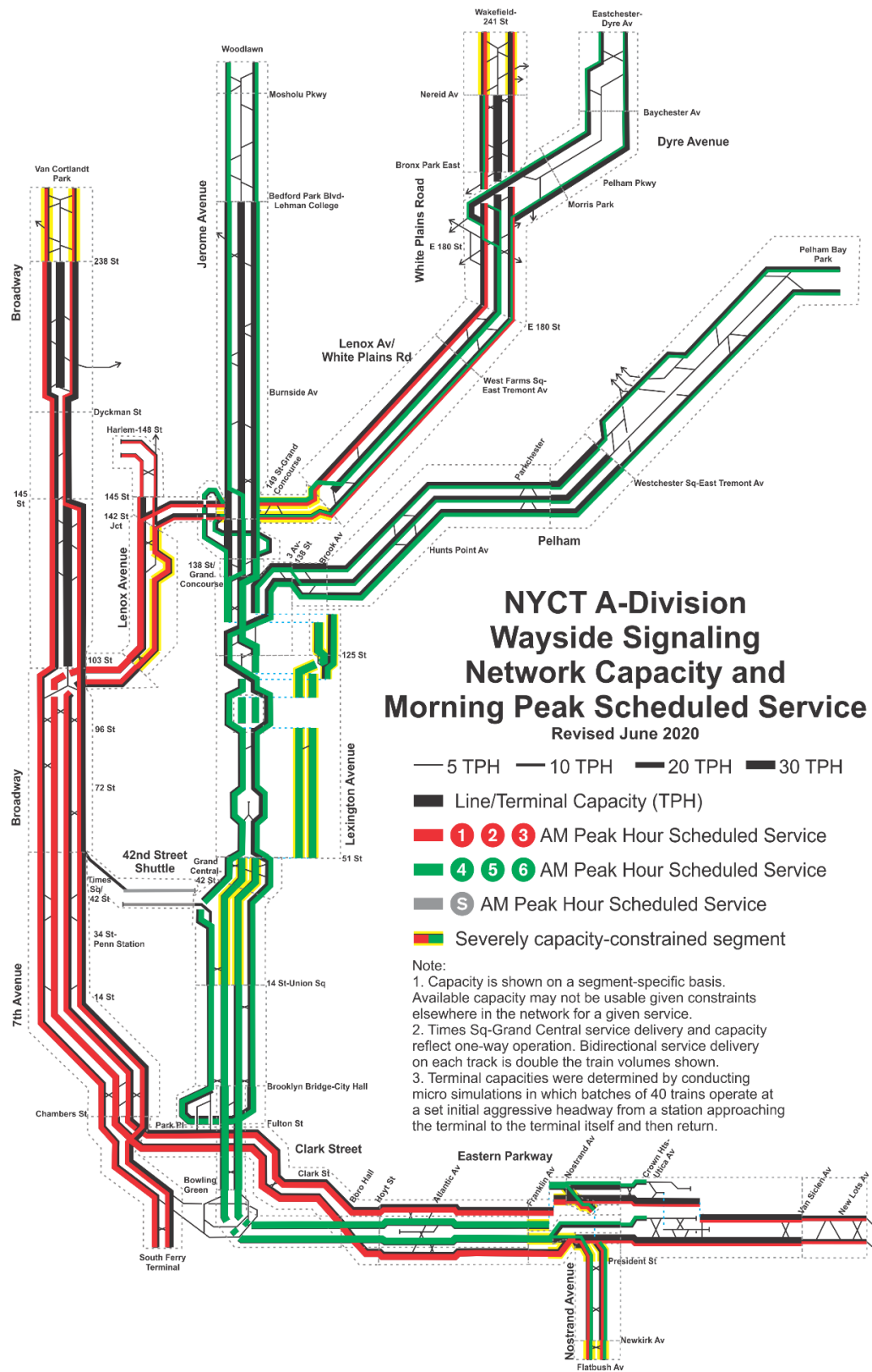
Peak period service delivery is represented by colored lines corresponding to each of the services (volumes associated with 2 Line and 3 Line trains are combined when operating on the same tracks in Manhattan as are the 4 Line and 5 Line trains), while available line and terminal capacity is represented by black lines. On three-track segments in the Bronx, capacity on the middle track is shown in the peak direction, i.e. southbound in the morning and northbound in the evening.

Thicker black lines correspond to territories with higher capacity. In segments where colored lines fully cover the underlying black lines, there is no available capacity. Gray boxes separate regions where localized track capacity changes; within each box, capacity presented in the graphic is constant. Southbound and northbound line thicknesses do not necessarily match, as they reflect the peak hour operation for each line and direction. Therefore, southbound and northbound peak hour service levels may be different.

Available capacity in one segment may not be utilizable if the line is capacity-constrained at other points in the network. Please note that some track segments with available capacity may not have sufficient passenger demand to justify increasing service even if operationally feasible.

FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

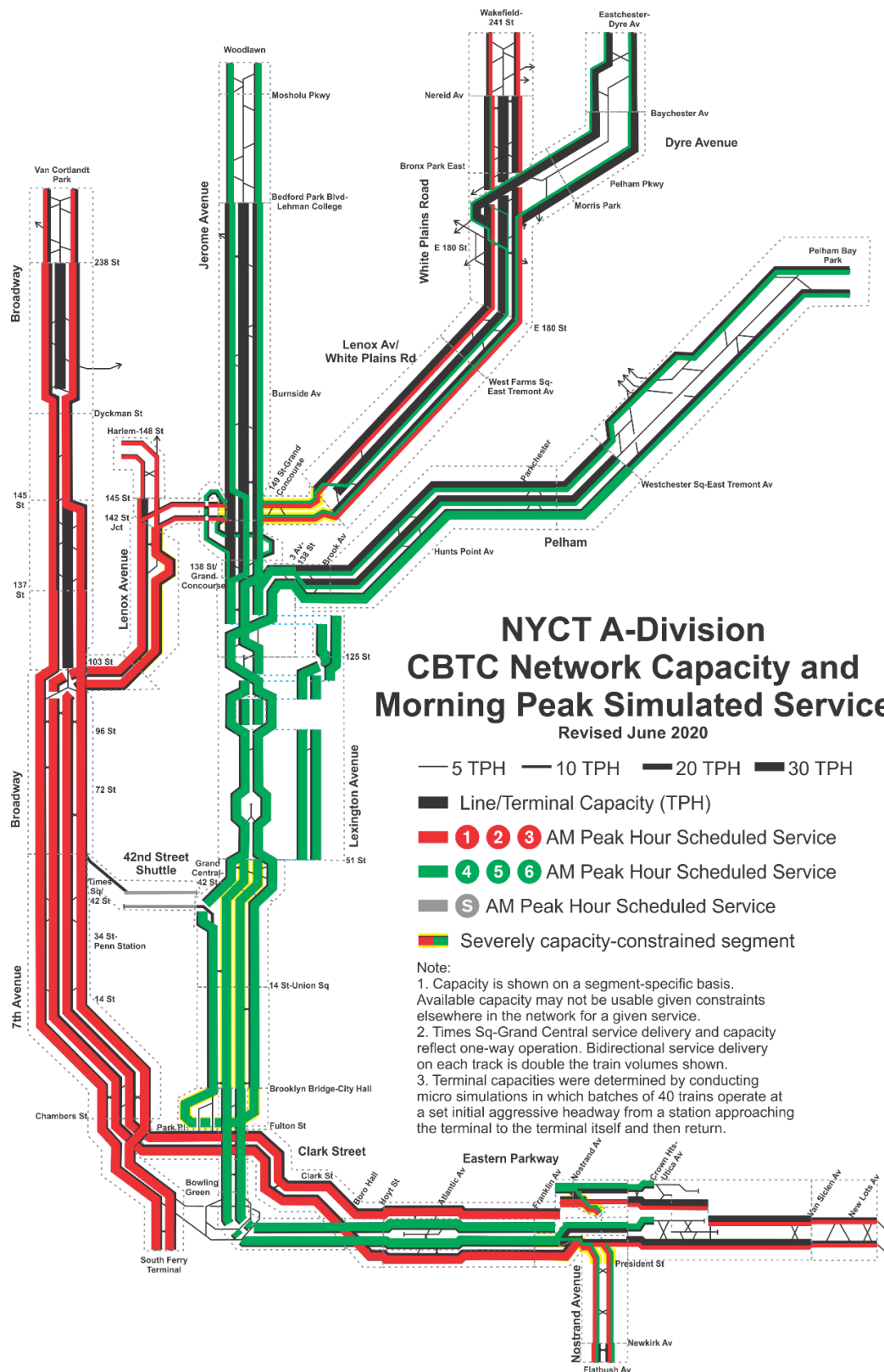
Figure C.2-2: Wayside Network Capacity and Morning Peak Scheduled Service



For capacity details refer to Table F.5-1.

FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

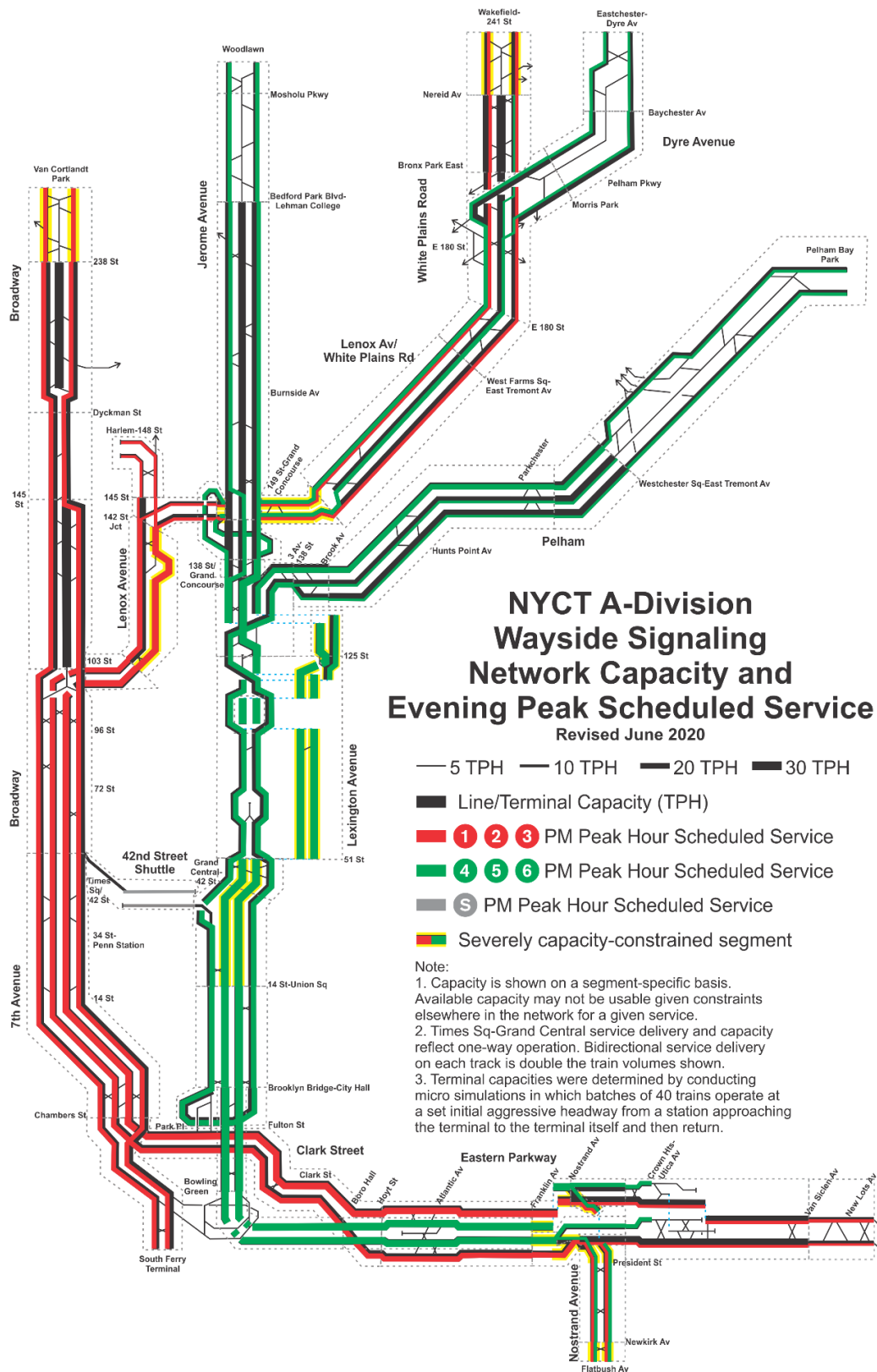
Figure C.2-3:CBTC Network Capacity and Morning Peak Simulated Service



For capacity details refer to Table G.7-1.

FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

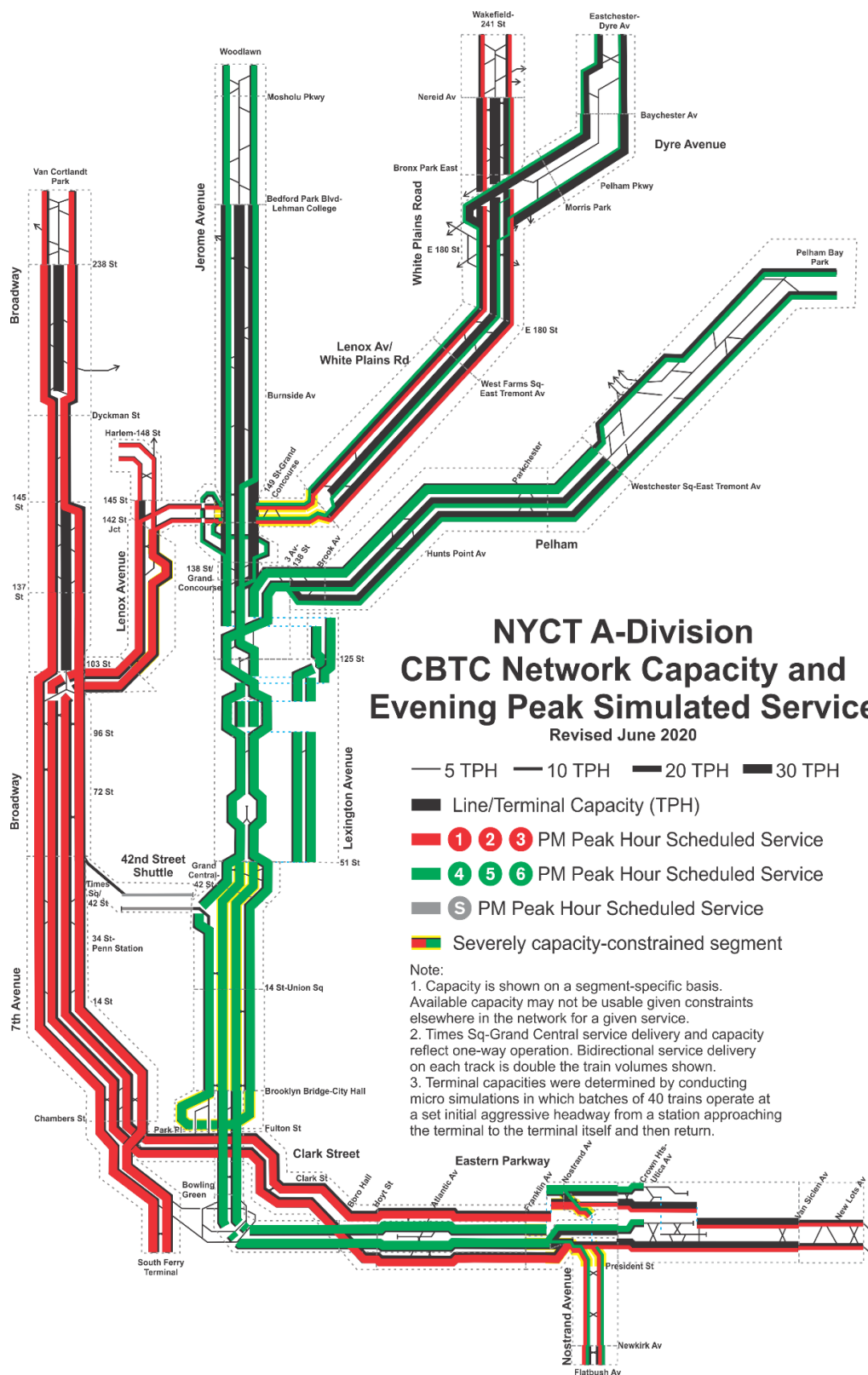
Figure C.2-4: Wayside Network Capacity and Evening Peak Scheduled Service



For capacity details refer to Table F.5-2.

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Figure C.2-5: CBTC Network Capacity and Evening Peak Scheduled Service



For capacity details refer to Table G.7-2.

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C.2.3 Simulated Terminal Capacity

The Phase I terminal configurations and associated capital improvements at Flatbush Avenue - Brooklyn College and New Lots Avenue were evaluated in terms of peak trains per hour capacity. The concept designs for capital improvements were provided by the Utica Avenue Corridor Study Team.

At Flatbush Avenue - Brooklyn College, terminal capacity was evaluated with the assumption that ② Line and ⑤ Line services can use either platform. For the Future Baseline network simulations, it was assumed that the ② Line and ⑤ Line services have dedicated terminal tracks, consistent with current operation and reflecting more conservative operating assumptions.

Several infrastructure improvements at the terminal were also evaluated:

- Replacement of the existing #8 standard turnouts north of the terminal with #10 tangential turnouts, facilitating an increase in diverging speeds from 15 MPH to 26.5 MPH (25 MPH in practice);
- A 77-foot southward track extension beyond the existing platform, improving platform entry speed; and
- Combined crossover and track extension improvements.

The terminal microsimulations found that the combined improvements resulted in a 4 TPH capacity gain. Of these capacity improvements, 3 of the 4 TPH were found to be associated with the #10 tangential turnouts. Therefore, the revenue side interlocking improvements are recommended for advancement to the capital improvements analysis phase of this study. The tail track extension is not recommended given the limited capacity gain and the associated longer passenger walking times between side platforms at Flatbush Avenue – Brooklyn College.

The New Lots Avenue terminal operation is similar to Flatbush Avenue - Brooklyn College except that only one service (the ③ Line) normally operates to New Lots Avenue and the terminal operation is complicated by train put-ins and pull-outs to and from Livonia Yard. As with the other site-specific terminal operations, the analysis found that the closer train spacing and higher speeds possible with CBTC will provide an increase in terminal capacity in the future.

The New Lots Avenue terminal capacity improvement identified by the Utica Avenue Corridor Study Team evaluated capital improvements entailing replacement of the #6 AREMA universal crossover with a #10 tangential diamond crossover. This would improve diverging movement speeds from 11 MPH to 26.5 MPH (10 MPH to 25 MPH in practice). The interlocking therefore would be converted from a staggered universal interlocking to a diamond crossover interlocking.

The terminal microsimulations found that the New Lots Avenue Interlocking improvements would increase CBTC terminal capacity from 23 TPH to 32 TPH when no yard put-ins or lay-ups operate (that is, terminal operation is limited to turns to and from the mainline). With six hourly trips to or from Livonia Yard, New Lots Avenue terminal capacity under CBTC would increase from 18 TPH to 20 TPH, in addition to the yard put-ins or lay-ups. The New Lots Avenue Interlocking improvements are recommended for advancement to the capital improvements analysis phase of this study.

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In addition to terminal congestion at Flatbush Avenue - Brooklyn College and New Lots Avenue, the 2 Line and 3 Line experience the greatest amount of signal delay under CBTC operation at the following locations:

- Nostrand Junction
- Harlem - 148 Street
- 142 Street Junction

The 1 Line service experienced congestion in the Future Baseline simulation at South Ferry and Van Cortlandt Park - 242 Street. All these locations are recommended for site-specific concept capital improvements investigation in Part D of this study.

The 4 Line, 5 Line, and 6 Line experience the greatest amount of signal delay under CBTC operation at the following locations:

- Crown Heights - Utica Avenue
- Brooklyn Bridge – City Hall
- 14 Street - Union Square to 125 Street on the Lexington Avenue Line northbound express track
- Pelham Bay Park

These locations are recommended for investigation in terms of conceptual capital improvements in Part D of this study.

FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

C.3 Future Baseline (CBTC) Results

Future Baseline (CBTC) results include simulated velocity profiles, end terminal on-time performance (which is compared with NYCT-reported data from the last year), average speeds, peak service delivery (simulated versus scheduled), terminal capacity results, time-distance string charts, terminal occupancy charts and delay locations across the simulated network. The baseline CBTC results are compared with existing wayside simulation results in terms of end-terminal on-time performance, average speeds and peak service delivery. Future simulation scenarios will compare improvements versus existing operation in terms of end-terminal on-time performance, average speeds and peak service delivery.

The input data, assumptions, and methodology used to produce the results in this section are included in Section G.1.

C.3.1 Simulated Travel Times

C.3.1.1 Simulated Travel Times by Line

Table C.3-1 shows simulated travel times by line, reflecting results for the morning and evening peak periods for the Baseline simulation. Table C.3-2 shows the simulated travel times for the Future Baseline (CBTC) simulation. Only trips operating entirely within the 6 a.m. to 10 a.m. or 3 p.m. to 7 p.m. time periods are reflected. The table shows minimum, maximum and average travel times by line by direction. Morning and evening peak period results are shown separately and combined.

Table C.3-1. Simulated Travel Times by Line – Existing Baseline (Wayside Signaling)

Line	Peak Period	Northbound			Southbound			Overall		
		Min	Max	Average	Min	Max	Average	Min	Max	Average
1	AM	0:58:14	1:00:46	0:58:43	0:58:50	1:03:32	1:00:21	0:58:14	1:03:32	0:59:33
	PM	1:00:00	1:04:04	1:00:54	0:57:15	0:58:47	0:57:47	0:57:15	1:04:04	0:59:23
	Both	0:58:14	1:04:04	1:00:00	0:57:15	1:03:32	0:58:54	0:57:15	1:04:04	0:59:27
2	AM	1:37:58	1:43:03	1:40:15	1:40:14	1:56:03	1:49:44	1:37:58	1:56:03	1:45:25
	PM	1:40:31	1:50:03	1:45:19	1:42:24	1:51:18	1:46:12	1:40:31	1:51:18	1:45:49
	Both	1:37:58	1:50:03	1:42:47	1:40:14	1:56:03	1:47:52	1:37:58	1:56:03	1:45:38
3	AM	1:10:17	1:18:40	1:13:27	1:07:46	1:24:38	1:13:03	1:07:46	1:24:38	1:13:13
	PM	1:11:27	1:30:22	1:19:15	1:08:24	1:17:10	1:12:00	1:08:24	1:30:22	1:15:46
	Both	1:10:17	1:30:22	1:16:44	1:07:46	1:24:38	1:12:33	1:07:46	1:30:22	1:14:33
4	AM	1:05:03	1:13:42	1:08:57	1:06:41	1:18:17	1:11:54	1:05:03	1:18:17	1:10:47
	PM	1:05:50	1:23:39	1:12:23	1:06:17	1:15:55	1:10:14	1:05:50	1:23:39	1:11:19
	Both	1:05:03	1:23:39	1:10:54	1:06:17	1:18:17	1:11:10	1:05:03	1:23:39	1:11:03
5	AM	1:23:30	1:30:27	1:26:23	1:24:29	1:40:22	1:32:48	1:23:30	1:40:22	1:29:22
	PM	1:22:46	1:33:50	1:27:36	1:28:07	1:40:12	1:36:01	1:22:46	1:40:12	1:32:54
	Both	1:22:46	1:33:50	1:26:52	1:24:29	1:40:22	1:34:37	1:22:46	1:40:22	1:31:06
6	AM	0:59:54	1:02:09	1:00:14	0:57:16	1:02:27	0:58:59	0:57:16	1:02:27	0:59:33
	PM	0:57:58	1:01:14	0:58:49	1:00:55	1:08:03	1:03:12	0:57:58	1:08:03	1:00:55
	Both	0:57:58	1:02:09	0:59:27	0:57:16	1:08:03	1:01:03	0:57:16	1:08:03	1:00:16

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Table C.3-2. Simulated Travel Times by Line – Future Baseline (CBTC)

Line	Peak Period	Northbound			Southbound			Overall		
		Min	Max	Average	Min	Max	Average	Min	Max	Average
1	AM	0:49:25	0:56:45	0:53:37	0:49:30	0:56:17	0:52:34	0:49:25	0:56:45	0:53:07
	PM	0:49:39	0:59:25	0:54:27	0:49:39	0:53:52	0:52:23	0:49:39	0:59:25	0:53:21
	Both	0:49:25	0:59:25	0:54:02	0:49:30	0:56:17	0:52:28	0:49:25	0:59:25	0:53:14
2	AM	1:21:37	1:28:07	1:25:16	1:24:07	1:33:27	1:26:12	1:21:37	1:33:27	1:25:44
	PM	1:24:19	1:31:16	1:27:35	1:20:54	1:27:14	1:24:40	1:20:54	1:31:16	1:26:03
	Both	1:21:37	1:31:16	1:26:30	1:20:54	1:33:27	1:25:20	1:20:54	1:33:27	1:25:54
3	AM	0:57:10	1:03:15	0:59:41	0:57:02	1:02:11	0:59:11	0:57:02	1:03:15	0:59:25
	PM	1:00:01	1:04:46	1:01:31	0:57:47	1:05:29	1:00:54	0:57:47	1:05:29	1:01:13
	Both	0:57:10	1:04:46	1:00:39	0:57:02	1:05:29	1:00:01	0:57:02	1:05:29	1:00:19
4	AM	0:54:31	1:01:32	0:57:31	0:56:44	1:05:21	1:00:31	0:54:31	1:05:21	0:59:16
	PM	0:55:09	1:01:41	0:58:15	0:57:18	1:02:59	1:00:10	0:55:09	1:02:59	0:59:16
	Both	0:54:31	1:01:41	0:57:55	0:56:44	1:05:21	1:00:21	0:54:31	1:05:21	0:59:16
5	AM	1:11:42	1:16:59	1:14:08	1:08:39	1:11:37	1:10:05	1:08:39	1:16:59	1:12:44
	PM	1:07:54	1:17:28	1:11:14	1:11:54	1:15:21	1:13:51	1:07:54	1:17:28	1:13:06
	Both	1:07:54	1:17:28	1:13:12	1:08:39	1:15:21	1:12:41	1:07:54	1:17:28	1:12:55
6	AM	0:54:23	0:59:56	0:57:48	0:48:58	0:51:33	0:49:46	0:48:58	0:59:56	0:53:50
	PM	0:50:25	0:54:37	0:51:51	0:54:25	0:57:42	0:55:47	0:50:25	0:57:42	0:53:51
	Both	0:50:25	0:59:56	0:54:52	0:48:58	0:57:42	0:52:49	0:48:58	0:59:56	0:53:50

Table C.3-3 compares travel time differences between wayside signaling (Table C.3-1) and CBTC operation (Table C.3-2). Negative values indicate that travel times are faster under CBTC than under wayside signaling. For example, the overall average travel time for the 1 Line is 0:06:26 faster under CBTC (0:53:07) than under wayside signaling (0:59:33).

Table C.3-3. Travel Time Comparison (Wayside vs. CBTC Signaling)

Line	Peak Period	Northbound			Southbound			Overall		
		Min	Max	Average	Min	Max	Average	Min	Max	Average
1	AM	-0:08:48	-0:04:01	-0:05:06	-0:09:20	-0:07:15	-0:07:47	-0:08:48	-0:06:47	-0:06:26
	PM	-0:10:21	-0:04:38	-0:06:27	-0:07:36	-0:04:55	-0:05:24	-0:07:36	-0:04:38	-0:06:03
	Both	-0:08:48	-0:04:38	-0:05:58	-0:07:45	-0:07:15	-0:06:26	-0:07:49	-0:04:38	-0:06:13
2	AM	-0:16:21	-0:14:56	-0:15:00	-0:16:07	-0:22:36	-0:23:32	-0:16:21	-0:22:36	-0:19:42
	PM	-0:16:12	-0:18:46	-0:17:44	-0:21:30	-0:24:05	-0:21:32	-0:19:37	-0:20:02	-0:19:47
	Both	-0:16:21	-0:18:46	-0:16:17	-0:19:20	-0:22:36	-0:22:32	-0:17:04	-0:22:36	-0:19:44
3	AM	-0:13:07	-0:15:26	-0:13:46	-0:10:44	-0:22:27	-0:13:52	-0:10:44	-0:21:23	-0:13:48
	PM	-0:11:25	-0:25:37	-0:17:43	-0:10:37	-0:11:42	-0:11:06	-0:10:37	-0:24:54	-0:14:34
	Both	-0:13:07	-0:25:37	-0:16:05	-0:10:44	-0:19:09	-0:12:32	-0:10:44	-0:24:54	-0:14:14
4	AM	-0:10:32	-0:12:10	-0:11:26	-0:09:57	-0:12:56	-0:11:23	-0:10:32	-0:12:56	-0:11:31
	PM	-0:10:41	-0:21:59	-0:14:09	-0:08:59	-0:12:56	-0:10:04	-0:10:41	-0:20:40	-0:12:03
	Both	-0:10:32	-0:21:59	-0:12:59	-0:09:33	-0:12:56	-0:10:49	-0:10:32	-0:18:18	-0:11:47
5	AM	-0:11:48	-0:13:27	-0:12:16	-0:15:51	-0:28:45	-0:22:43	-0:14:51	-0:23:23	-0:16:38
	PM	-0:14:52	-0:16:22	-0:16:23	-0:16:13	-0:24:51	-0:22:10	-0:14:52	-0:22:43	-0:19:48
	Both	-0:14:52	-0:16:22	-0:13:40	-0:15:51	-0:25:01	-0:21:56	-0:14:52	-0:22:54	-0:18:11
6	AM	-0:05:31	-0:02:13	-0:02:25	-0:08:17	-0:10:53	-0:09:13	-0:08:17	-0:02:30	-0:05:43
	PM	-0:07:32	-0:06:37	-0:06:58	-0:06:29	-0:10:21	-0:07:25	-0:07:32	-0:10:21	-0:07:05
	Both	-0:07:32	-0:02:13	-0:04:35	-0:08:17	-0:10:21	-0:08:14	-0:08:17	-0:08:06	-0:06:25

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C.3.2 Terminal On-Time Performance

NYCT maintains a legacy statistic, terminal on-time performance, that measures lateness versus schedule. This statistic is considered a legacy statistic because it does not measure the experience of most customers, who ride trains for middle segments of lines but do not actually use services to an end terminal. Trips that arrive early, precisely on schedule or no more than 5 minutes late are considered “on time”. Table C.3-4 displays A-Division terminal on-time performance by line including average reported on-time performance for the 12 months ending in November 2019.

Table C.3-4. A-Division Reported Terminal On-Time Performance by Line – Dec 2018 to Nov 2019

Subway Line	December 2018	January 2019	February 2019	March 2019	April 2019	May 2019	June 2019	July 2019	August 2019	September 2019	October 2019	November 2019	Average
1	78.0%	85.1%	83.6%	86.0%	87.1%	83.8%	82.6%	85.3%	88.2%	90.5%	86.0%	84.2%	85.0%
2	61.9%	72.4%	72.1%	72.0%	76.0%	73.6%	75.6%	71.0%	76.1%	78.2%	79.0%	81.2%	74.1%
3	74.0%	82.6%	85.2%	79.7%	85.9%	82.0%	81.9%	80.6%	85.8%	88.5%	88.9%	89.3%	83.7%
4	61.7%	66.0%	70.3%	73.9%	75.7%	74.0%	74.0%	74.4%	79.8%	76.1%	77.4%	76.6%	73.3%
5	70.1%	74.4%	75.8%	78.8%	81.4%	79.7%	81.5%	75.3%	81.8%	78.6%	80.7%	79.5%	78.1%
6	72.5%	72.2%	74.4%	75.5%	75.1%	76.2%	79.3%	80.9%	87.2%	78.5%	77.0%	77.5%	77.2%
S	99.8%	99.9%	99.8%	99.7%	99.8%	99.8%	99.9%	99.4%	99.5%	99.5%	98.3%	98.1%	99.5%
Average*	76.3%	80.7%	81.5%	82.3%	84.0%	82.7%	83.5%	83.0%	86.9%	84.9%	84.2%	84.1%	82.8%

Note: *MTA reports the Average On-Time Performance per month as the above. The straight mathematical average per month is lower. For example, in December 2018, MTA reports the average to be 76.3% but the straight mathematical average is 74.0%.

Table C.3-5 displays simulated on-time performance by line and by lateness threshold. The 5-minute lateness threshold is comparable to the NYCT-reported terminal on-time performance.

Table C.3-5. Simulated Terminal On-Time Performance by Line – Calibration Baseline (Wayside Signaling)

Lateness Threshold	00:00:00		00:05:00		00:10:00		All Stops	
Subway Line	Stops	Pct (%)	Stops	Pct (%)	Stops	Pct (%)	Stops	Pct (%)
1	101	21.9%	427	92.4%	450	97.4%	462	100%
2	74	22.8%	263	81.2%	317	97.8%	324	100%
3	197	64.4%	285	93.1%	304	99.3%	306	100%
4	257	69.5%	339	91.6%	361	97.6%	370	100%
5	114	34.7%	306	93.0%	321	97.6%	329	100%
6	227	41.7%	493	90.6%	536	98.5%	544	100%
Combined	970	41.5%	2,113	90.5%	2,289	98.0%	2,335	100%
S	507	99.8%	508	100.0%	508	100.0%	508	100%

Table C.3-6 displays Future Baseline (CBTC) on-time performance for each line for three different end terminal lateness thresholds. Using a five-minute lateness threshold, the overall simulation shows a 94.8 percent OTP. This reflects tighter (shorter) scheduled run times so the improvement

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is even more significant than the 94.8 percent (Table C.3-6) versus 90.5 percent (Table C.3-5) simulated OTP gain.

Although ③ Line on-time performance appears to decrease from 93.1 percent under wayside operation to 90.8 percent under CBTC operation, several differences between the wayside and CBTC simulation models prevent a direct comparison. Scheduled run times for each line are shorter in the CBTC simulation model while the number of peak period trains is higher. Operating at higher frequencies under CBTC also results in additional congestion at Harlem - 148 Street, as the terminal balances turning revenue trains and non-revenue drill moves from Lenox Yard.

**Table C.3-6. Simulated Terminal On-Time Performance by Line –
Future Baseline (CBTC)**

NOTE: Not comparable to Existing Baseline OTP. Assumes shorter scheduled CBTC run times.

Lateness Threshold	00:00:00		00:05:00		00:10:00		All Stops	
Subway Line	Stops	Pct (%)	Stops	Pct (%)	Stops	Pct (%)	Stops	Pct (%)
①	149	23.2%	597	93.0%	641	99.8%	642	100%
②	91	25.0%	341	93.7%	361	99.2%	364	100%
③	66	19.6%	306	90.8%	336	100%	337	100%
④	236	53.0%	438	98.4%	445	100%	445	100%
⑤	194	64.9%	282	94.3%	298	100%	299	100%
⑥	393	61.0%	626	97.2%	640	99.4%	644	100%
Combined	1,129	41.3%	2,590	94.8%	2,721	99.6%	2,731	100%
Ⓢ	282	50.0%	564	100.0%	564	100.0%	564	100%

C.3.3 Peak Service Delivery

Existing baseline (wayside signaling) and future baseline (CBTC) operations were evaluated in terms of simulated peak service delivery at several key locations throughout the study area. Service delivery is measured in terms of trains passing in the peak 60 minutes during the morning and evening. Peak periods and service deliveries are only reported in this section if they fall completely within the 6 a.m. to 10 a.m. or 2 p.m. to 8 p.m. time periods. Comparing simulated versus scheduled operation is very useful in understanding where capacity-constrained operations prevent full scheduled service delivery. Comparing peak service delivery for wayside signaling versus CBTC is also useful even though the underlying simulated operating plans (scheduled TPH) are different.

Note that in this simulation branch lines will accommodate 20 TPH comfortably, while junctions and trunk lines are stressed at 30 TPH.

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C.3.3.1 Nevins Street

Table C.3-7. Scheduled and Simulated Peak Service Delivery – Nevins Street

Morning Peak Service Delivery						
			② ③ Line		④ ⑤ Line	
			Wayside Signaling	CBTC	Wayside Signaling	CBTC
Northbound	Scheduled	TPH	19	28	23	31
		Peak Hour	8:40 – 9:40	7:29 – 8:29	8:08 – 9:08	8:10 – 9:10
	Simulated	TPH	20	27	24	32
		Peak Hour	8:59 – 9:59	7:50 – 8:50	8:09 – 9:09	8:28 – 9:28
Southbound	Scheduled	TPH	22	26	24	31
		Peak Hour	8:11 – 9:11	6:54 – 7:54	8:01 – 9:01	7:21 – 8:21
	Simulated	TPH	23	27	25	30
		Peak Hour	8:12 – 9:12	7:19 – 8:19	7:49 – 8:49	7:15 – 8:15
Evening Peak Service Delivery						
			② ③ Line		④ ⑤ Line	
			Wayside Signaling	CBTC	Wayside Signaling	CBTC
Northbound	Scheduled	TPH	22	28	26	31
		Peak Hour	16:41 - 17:41	17:23 – 18:23	17:17 - 18:17	17:09 – 18:09
	Simulated	TPH	22	27	26	32
		Peak Hour	16:42 - 17:42	16:30 – 17:30	17:15 - 18:15	17:08 – 18:08
Southbound	Scheduled	TPH	19	25	25	31
		Peak Hour	16:51 - 17:51	15:56 – 16:56	16:44 - 17:44	16:21 – 17:21
	Simulated	TPH	20	26	26	32
		Peak Hour	17:02 - 18:02	16:49 – 17:49	16:45 - 17:45	16:29 – 17:29

FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

C.3.3.2 Grand Central - 42 Street

The longest dwell time of 55 seconds occurs during the p.m. peak period on the northbound express track at Grand Central-42 Street. As a result, northbound service on the 4 and 5 Lines is constrained at 29 TPH during this period.

Northbound express service experiences additional congestion as CBTC treats the lengthy interlocking immediately north of the station as one fixed block. 4 Line and 5 Line trains therefore experience congestion entering the station while waiting for the preceding train to clear both the platform and interlocking. As a result, Grand Central - 42 Street is considered the primary capacity constraint for Lexington Avenue express service.

Table C.3-8. Scheduled and Simulated Peak Service Delivery – Grand Central-42 Street

Morning Peak Service Delivery						
			4 5 Line		6 Line	
			Wayside Signaling	CBTC	Wayside Signaling	CBTC
Northbound	Scheduled	TPH	25	32	19	31
		Peak Hour	8:31 – 9:31	8:40 – 9:40	8:26 – 9:26	8:09 – 9:09
	Simulated	TPH	26	32	20	30
		Peak Hour	8:28 – 9:28	8:45 – 9:45	8:35 – 9:35	7:44 – 8:44
Southbound	Scheduled	TPH	27	31	20	30
		Peak Hour	7:36 – 8:36	7:03 – 8:03	7:50 – 8:50	7:17 – 8:17
	Simulated	TPH	27	31	20	30
		Peak Hour	7:29 – 8:29	7:09 – 8:09	7:36 – 8:36	7:12 – 8:12
Evening Peak Service Delivery						
			4 5 Line		6 Line	
			Wayside Signaling	CBTC	Wayside Signaling	CBTC
Northbound	Scheduled	TPH	27	31	18	31
		Peak Hour	17:42 - 18:42	17:27 – 18:27	16:29 - 17:29	17:09 – 18:09
	Simulated	TPH	25	29	19	31
		Peak Hour	17:03 - 18:03	16:25 – 17:25	16:22 - 17:22	16:19 – 17:19
Southbound	Scheduled	TPH	26	31	18	30
		Peak Hour	15:46 – 16:46	16:03 – 17:03	15:41 - 16:41	15:39 – 16:39
	Simulated	TPH	27	32	19	31
		Peak Hour	16:18 - 17:18	16:09 – 17:09	15:48 – 16:48	15:37 – 16:37

FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

C.3.3.3 125 Street

Northbound service on the ④ and ⑤ Lines is constrained at 29 TPH during the p.m. peak period, as congestion at the primary capacity constraint of Grand Central - 42 Street cascades up to 125 Street.

Table C.3-9. Scheduled and Simulated Peak Service Delivery – 125 Street

Morning Peak Service Delivery						
			④ ⑤ Line		⑥ Line	
			Wayside Signaling	CBTC	Wayside Signaling	CBTC
Northbound	Scheduled	TPH	25	32	19	31
		Peak Hour	8:43 – 9:43	8:49 – 9:49	8:42 – 9:42	8:23 – 9:23
	Simulated	TPH	24	32	20	30
		Peak Hour	8:47 – 9:47	8:54 – 9:54	8:51 – 9:51	7:59 – 8:59
Southbound	Scheduled	TPH	28	31	20	30
		Peak Hour	7:23 – 8:23	6:54 – 7:54	7:22 – 8:22	6:59 – 7:59
	Simulated	TPH	27	31	20	30
		Peak Hour	7:18 – 8:18	6:59 – 7:59	7:18 – 8:18	6:56 – 7:56
Evening Peak Service Delivery						
			④ ⑤ Line		⑥ Line	
			Wayside Signaling	CBTC	Wayside Signaling	CBTC
Northbound	Scheduled	TPH	27	31	18	31
		Peak Hour	17:55 - 18:55	17:36 – 18:36	16:47 - 17:47	17:23 – 18:23
	Simulated	TPH	23	29	19	31
		Peak Hour	16:46 - 17:46	16:44 – 17:44	16:40 - 17:40	16:37 – 17:37
Southbound	Scheduled	TPH	26	31	18	30
		Peak Hour	15:34 - 16:34	15:54 – 16:54	15:24 - 16:24	15:21 – 16:21
	Simulated	TPH	27	32	19	31
		Peak Hour	16:07 - 17:07	16:00 – 17:00	15:28 - 16:28	15:21 – 16:21

FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

C.3.3.4 Times Square - 42 Street

Table C.3-10. Scheduled and Simulated Peak Service Delivery – Times Square-42 Street

Morning Peak Service Delivery						
			① Line		② ③ Line	
			Wayside Signaling	CBTC	Wayside Signaling	CBTC
Northbound	Scheduled	TPH	19	32	19	28
		Peak Hour	8:52 – 9:52	8:37 - 9:37	8:55 – 9:55	8:48 – 9:48
	Simulated	TPH	18	31	18	27
		Peak Hour	8:32 – 9:32	8:25 – 9:25	7:56 – 8:56	8:08 – 9:08
Southbound	Scheduled	TPH	18	31	22	26
		Peak Hour	7:53 – 8:53	8:00 – 9:00	7:42 - 8:42	6:36 – 7:36
	Simulated	TPH	19	32	23	27
		Peak Hour	7:56 – 8:56	8:13 – 9:13	7:50 - 8:50	7:01 – 8:01
Evening Peak Service Delivery						
			① Line		② ③ Line	
			Wayside Signaling	CBTC	Wayside Signaling	CBTC
Northbound	Scheduled	TPH	16	31	22	28
		Peak Hour	17:14 - 18:14	17:14 – 18:14	17:12 - 18:12	17:42 – 18:42
	Simulated	TPH	16	31	22	27
		Peak Hour	17:05 - 18:05	18:14 – 19:14	17:05 - 18:05	16:50 – 17:50
Southbound	Scheduled	TPH	16	31	19	25
		Peak Hour	16:25 - 17:25	17:36 – 18:36	16:17 - 17:17	15:38 – 16:38
	Simulated	TPH	17	31	20	26
		Peak Hour	16:40 - 17:40	17:15 – 18:15	16:40 - 17:40	16:30 – 17:30

FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

C.3.3.5 96 Street

Table C.3-11. Scheduled and Simulated Peak Service Delivery – 96 Street

Morning Peak Service Delivery						
			① Line		② ③ Line	
			Wayside Signaling	CBTC	Wayside Signaling	CBTC
Northbound	Scheduled	TPH	18	32	18	27
		Peak Hour	8:47 – 9:47	8:48 – 9:48	8:19 – 9:19	8:06 – 9:06
	Simulated	TPH	18	31	19	27
		Peak Hour	8:44 – 9:44	8:36 – 9:36	8:47 – 9:47	8:21 – 9:21
Southbound	Scheduled	TPH	18	31	23	26
		Peak Hour	7:41 – 8:41	7:59 – 8:59	7:34 – 8:34	6:30 – 7:30
	Simulated	TPH	19	32	23	27
		Peak Hour	7:43 – 8:43	8:03 – 9:03	7:40 – 8:40	6:54 – 7:54
Evening Peak Service Delivery						
			① Line		② ③ Line	
			Wayside Signaling	CBTC	Wayside Signaling	CBTC
Northbound	Scheduled	TPH	17	31	22	28
		Peak Hour	17:57 - 18:57	17:25 – 18:25	17:20 - 18:20	17:59 – 18:59
	Simulated	TPH	16	31	22	27
		Peak Hour	17:18 - 18:18	18:25 – 19:25	17:16 - 18:16	16:56 – 17:56
Southbound	Scheduled	TPH	16	31	19	25
		Peak Hour	16:14 - 17:14	17:25 – 18:25	16:09 - 17:09	15:32 – 16:32
	Simulated	TPH	17	31	20	26
		Peak Hour	16:28 - 17:28	17:02 – 18:02	16:32 - 17:32	16:24 – 17:24

FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

C.3.3.6 East 180 Street

There are notably fewer 5 Line trains in the CBTC network simulation than in the existing baseline simulation, as the model emphasizes 4 Line trains which can be more efficiently turned around at Crown Heights - Utica Avenue and do not consume critical capacity on the same Nostrand Junction track segment as is used by the 2 Line and 3 Line trains.

Table C.3-12. Scheduled and Simulated Peak Service Delivery – East 180 Street

Morning Peak Service Delivery						
			2 Line		5 Line	
			Wayside Signaling	CBTC	Wayside Signaling	CBTC
Northbound	Scheduled	TPH	9	13	13	11
		Peak Hour	8:39 – 9:39	8:25 – 9:25	8:59 – 9:59	8:47 – 9:47
	Simulated	TPH	9	14	12	11
		Peak Hour	8:19 – 9:19	8:47 – 9:47	8:48 – 9:48	8:27 – 9:27
Southbound	Scheduled	TPH	12	14	15	11
		Peak Hour	6:35 – 7:35	6:04 – 7:04	7:00 – 8:00	6:26 – 7:26
	Simulated	TPH	13	14	14	11
		Peak Hour	7:01 – 8:01	6:04 – 7:04	6:57 – 7:57	6:25 – 7:25
Evening Peak Service Delivery						
			2 Line		5 Line	
			Wayside Signaling	CBTC	Wayside Signaling	CBTC
Northbound	Scheduled	TPH	11	14	14	11
		Peak Hour	17:50 – 18:50	18:13 – 19:13	17:34 – 18:34	18:18 – 19:18
	Simulated	TPH	13	14	14	11
		Peak Hour	18:46 – 19:46	17:29 – 18:29	17:42 – 18:42	18:20 – 19:20
Southbound	Scheduled	TPH	11	13	14	11
		Peak Hour	16:11 – 17:11	15:02 – 16:02	14:51 – 15:51	15:37 – 16:37
	Simulated	TPH	11	14	14	11
		Peak Hour	16:19 – 17:19	15:15 – 16:15	14:59 – 15:59	15:37 – 16:37

FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

C.3.3.7 231 Street

231 Street sees fewer than 30 TPH during the peak period, as capacity constraints do not permit 30 TPH operation to 238 Street and 242 Street while simultaneously supporting put-ins and lay-ups from 240 Street Yard. Some ① Line trains must turn at the 137 Street Center Track and be staged (held until the peak of the peak) on the 137 Street yard tracks as a result.

Table C.3-13. Scheduled and Simulated Peak Service Delivery – 231 Street

Morning Peak Service Delivery				
			① Line	
			Wayside Signaling	CBTC
Northbound	Scheduled	TPH	12	27
		Peak Hour	8:58 – 9:58	8:59 – 9:59
	Simulated	TPH	12	26
		Peak Hour	9:00 – 10:00	8:42 – 9:42
Southbound	Scheduled	TPH	16	25
		Peak Hour	7:07 – 8:07	6:42 – 7:42
	Simulated	TPH	17	26
		Peak Hour	7:18 - 8:18	7:19 – 8:19
Evening Peak Service Delivery				
			① Line	
			Wayside Signaling	CBTC
Northbound	Scheduled	TPH	17	27
		Peak Hour	18:21 – 19:21	17:47 – 18:47
	Simulated	TPH	16	27
		Peak Hour	17:43 – 18:43	18:03 – 19:03
Southbound	Scheduled	TPH	16	26
		Peak Hour	15:50 - 16:50	16:24 – 17:24
	Simulated	TPH	17	26
		Peak Hour	16:04 – 17:04	16:25 – 17:25

FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

C.3.3.8 145 Street

Table C.3-14. Scheduled and Simulated Peak Service Delivery – 145 Street

Morning Peak Service Delivery				
			3 Line	
			Wayside Signaling	CBTC
Northbound	Scheduled	TPH	8	14
		Peak Hour	7:53 – 8:53	8:17 – 9:17
	Simulated	TPH	10	14
		Peak Hour	8:23 - 9:23	8:37 – 9:37
Southbound	Scheduled	TPH	12	13
		Peak Hour	7:22 - 8:22	6:17 – 7:17
	Simulated	TPH	12	14
		Peak Hour	7:24 – 8:24	6:37 – 7:37
Evening Peak Service Delivery				
			3 Line	
			Wayside Signaling	CBTC
Northbound	Scheduled	TPH	12	14
		Peak Hour	17:44 - 18:44	17:58 – 18:58
	Simulated	TPH	12	14
		Peak Hour	18:13 - 19:13	17:07 – 18:07
Southbound	Scheduled	TPH	9	13
		Peak Hour	14:56 – 15:56	16:29 – 17:29
	Simulated	TPH	9	13
		Peak Hour	14:56 – 15:56	16:13 – 17:13

FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

C.3.3.9 Burnside Avenue

Table C.3-15. Scheduled and Simulated Peak Service Delivery – Burnside Avenue

Morning Peak Service Delivery				
			4 Line	
			Wayside Signaling	CBTC
Northbound	Scheduled	TPH	12	21
		Peak Hour	7:55 - 8:55	8:49 - 9:49
	Simulated	TPH	13	21
		Peak Hour	7:57 - 8:57	8:49 - 9:49
Southbound	Scheduled	TPH	15	21
		Peak Hour	7:03 - 8:03	6:56 - 7:56
	Simulated	TPH	14	21
		Peak Hour	6:55 - 7:55	7:09 – 8:09
Evening Peak Service Delivery				
			4 Line	
			Wayside Signaling	CBTC
Northbound	Scheduled	TPH	14	22
		Peak Hour	18:07 - 19:07	16:45 – 17:45
	Simulated	TPH	13	21
		Peak Hour	18:56 - 19:56	16:41 – 17:41
Southbound	Scheduled	TPH	14	21
		Peak Hour	15:37 - 16:37	14:52 - 15:52
	Simulated	TPH	14	21
		Peak Hour	15:36 - 16:36	14:53 – 15:53

FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

C.3.3.10 Baychester Avenue

Table C.3-16. Scheduled and Simulated Peak Service Delivery – Baychester Avenue

Morning Peak Service Delivery				
			5 Line	
			Wayside Signaling	CBTC
Northbound	Scheduled	TPH	8	11
		Peak Hour	9:00 – 10:00	8:57 – 9:57
	Simulated	TPH	8	10
		Peak Hour	8:24 - 9:24	8:29 - 9:29
Southbound	Scheduled	TPH	8	8
		Peak Hour	7:34 – 8:34	8:13 - 9:13
	Simulated	TPH	8	8
		Peak Hour	7:37 – 8:37	8:13 - 9:13
Evening Peak Service Delivery				
			5 Line	
			Wayside Signaling	CBTC
Northbound	Scheduled	TPH	9	9
		Peak Hour	15:59 - 16:59	18:46 – 19:46
	Simulated	TPH	9	10
		Peak Hour	18:49 - 19:49	18:57 – 19:57
Southbound	Scheduled	TPH	11	11
		Peak Hour	14:58 - 15:58	15:30 – 16:30
	Simulated	TPH	11	11
		Peak Hour	14:59 - 15:59	15:30 – 16:30

FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

C.3.3.11 Hunts Point Avenue

Table C.3-17. Scheduled and Simulated Peak Service Delivery – Hunts Point Avenue

Morning Peak Service Delivery				
			6 Line	
			Wayside Signaling	CBTC
Northbound	Scheduled	TPH	17	30
		Peak Hour	8:59 – 9:59	8:15 - 9:15
	Simulated	TPH	17	30
		Peak Hour	8:59 – 9:59	8:20 - 9:20
Southbound	Scheduled	TPH	20	30
		Peak Hour	7:18 - 8:18	6:48 - 7:48
	Simulated	TPH	21	30
		Peak Hour	7:19 - 8:19	6:54 - 7:54
Evening Peak Service Delivery				
			6 Line	
			Wayside Signaling	CBTC
Northbound	Scheduled	TPH	18	30
		Peak Hour	16:59 - 17:59	17:11 – 18:11
	Simulated	TPH	19	31
		Peak Hour	17:06 - 18:06	16:48 - 17:48
Southbound	Scheduled	TPH	18	30
		Peak Hour	15:19 - 16:19	15:13 - 16:13
	Simulated	TPH	19	30
		Peak Hour	15:31 - 16:31	15:10 - 16:10

C.3.4 Capacity and Peak Service Delivery

Capacity is the total number of trains per hour the line can support. For wayside signaling, this is calculated by using the most constraining minimum supportable headway of any signal on the applicable line or track. Capacity equals one hour divided by the minimum supportable headway.

Determination of CBTC capacity for NYCT A-Division line segments requires saturating the line with simulated trains and measuring throughput at the end of the segment, similar to the A-Division terminal capacity analyses. Known capacity choke points, including Nostrand Junction, 142 Street Junction, and the Lexington Avenue Line between Bowling Green and 125 Street, were subjected to CBTC line capacity analysis. Based on the results of the Lexington Avenue Line analysis, a default line capacity of 36 TPH was established for areas outside of train crossing conflicts, long dwell times and/or severe curve-related speed restrictions.

For complete data on present or potential capacity constraints or “choke points” on 1 2 3 4 5 6 and S Lines in the Future Baseline (CBTC) model, refer to Table F.5-1 and Table F.5-2.

FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

The TrainOps® simulation results described above and the terminal capacity analyses described in Section C.3.6 were used to develop overall network capacity graphics showing simulated CBTC service versus CBTC line, junction and terminal capacity. The morning peak period is shown in Figure C.3-1 and the evening peak period is shown in Figure C.3-2. These reflect the operating plan and service levels as described in Section G.2, which shows detailed morning and evening peak service capacity for all station-station pairs throughout the network.

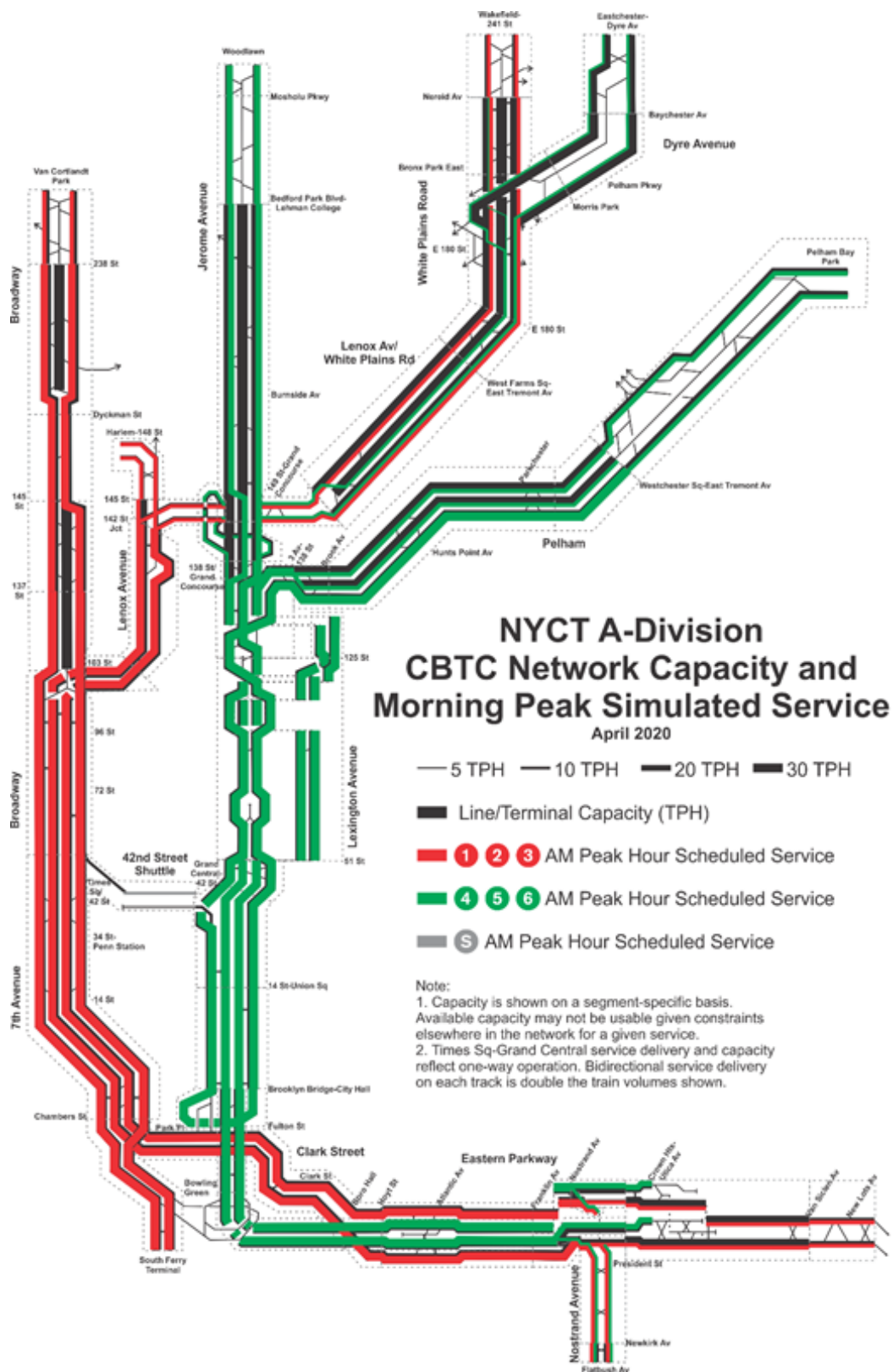
Peak period service delivery is represented by colored lines corresponding to each of the services (volumes associated with 2 Line and 3 Line trains are combined when operating on the same tracks in Manhattan as are the 4 Line and 5 Line trains), while available line and terminal capacity is represented by black lines.

Thicker black lines correspond to territories with higher capacity. In segments where colored lines fully cover the underlying black lines, there is no available capacity. Gray boxes separate regions where localized track capacity changes; within each box, capacity presented in the graphic is constant. Southbound and northbound line thicknesses do not necessarily match, as they reflect the peak hour operation for each line and direction. Therefore, southbound and northbound peak hour service levels may be different.

Available capacity in one segment may not be utilizable if the line is capacity-constrained at other points in the network. It should also be noted that some track segments with available capacity may not have enough passenger demand to justify increasing service even if unconstrained by line capacity constraints in other segments.

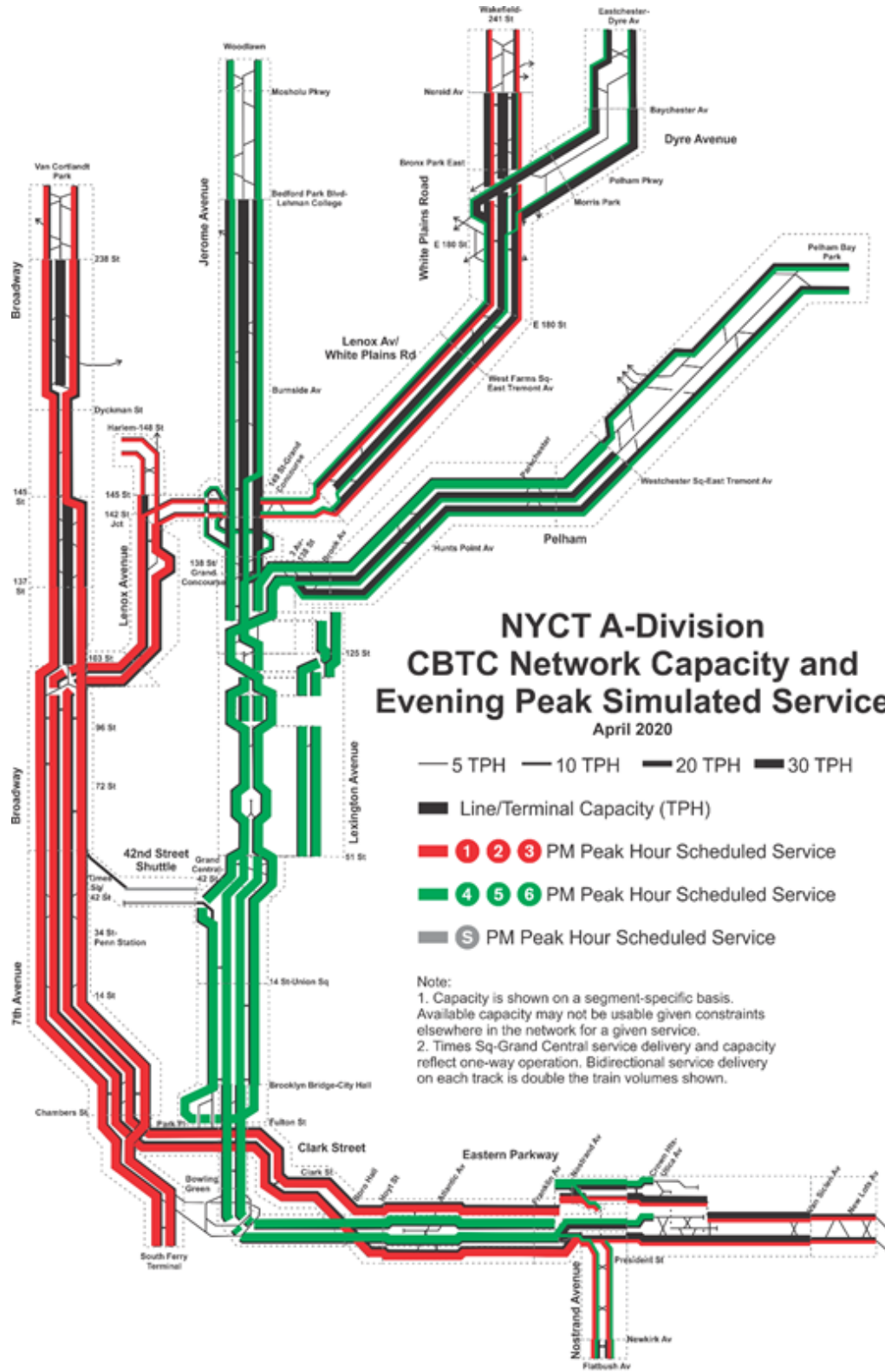
FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure C.3-1: CBTC Network Capacity and Morning Peak Simulated Service



FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure C.3-2: CBTC Network Capacity and Evening Peak Simulated Service



FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

C.3.5 Simulated Congestion Locations

Simulated congestion can be highlighted geographically by presenting length of signal delay per trip in each segment of the A-Division simulation.

C.3.5.1 Signal Delay

For the purpose of presenting signal delay graphically, a segment is defined as station-to-station. The STV Team computed simulated signal delay (in seconds) per trip, further dividing the statistics into East Side and West Side A-Division services. The figures use the following color conventions:

- Green: 0 to 10 seconds of signal delay per trip per segment
- Yellow: 11 to 30 seconds of signal delay per trip per segment
- Orange: 31 to 49 seconds of signal delay per trip per segment
- Red: 50 or more seconds of signal delay per trip per segment

Orange segments reflect significant congestion and red segments reflect severe congestion. Red segments should be targeted for mitigation through infrastructure and/or operating plan changes.

The ① ② ③ Lines experience the greatest amount of signal delay under CBTC operation at the following locations:

- Flatbush Avenue
- Nostrand Junction
- South Ferry
- Harlem-148 Street
- 142 Street Junction
- Van Cortlandt Park - 242 Street

The ④ ⑤ ⑥ Lines experience the greatest amount of signal delay under CBTC operation at the following locations:

- Crown Heights - Utica Avenue
- Flatbush Avenue – Brooklyn College
- Brooklyn Bridge – City Hall
- 14 Street-Union Square to 125 Street on the Lexington Avenue Line northbound express track
- Pelham Bay Park

FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure C.3-14 highlights Eastchester - Dyre Avenue as another significant source of signal delay along the 5 Line. As several 5 Line trips approach the terminal early and spend significant time waiting for the terminal tracks to clear, they exceed the per-trip delay threshold and thus warrant inclusion in the graphic.

FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure C.3-3: Phase I Schematic highlighting signal delay for the 1, 2 and 3 Lines – Existing Baseline (Wayside)

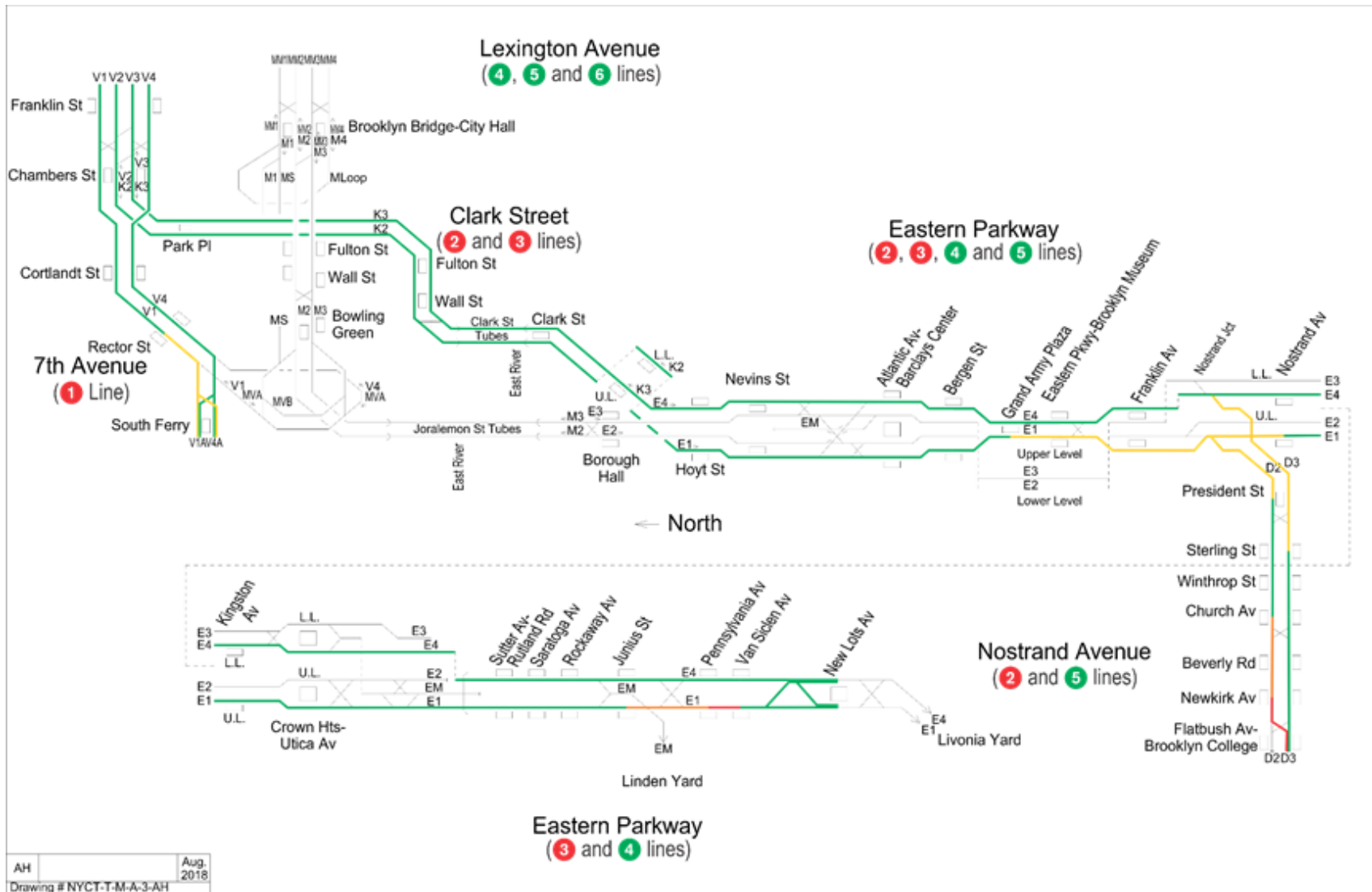
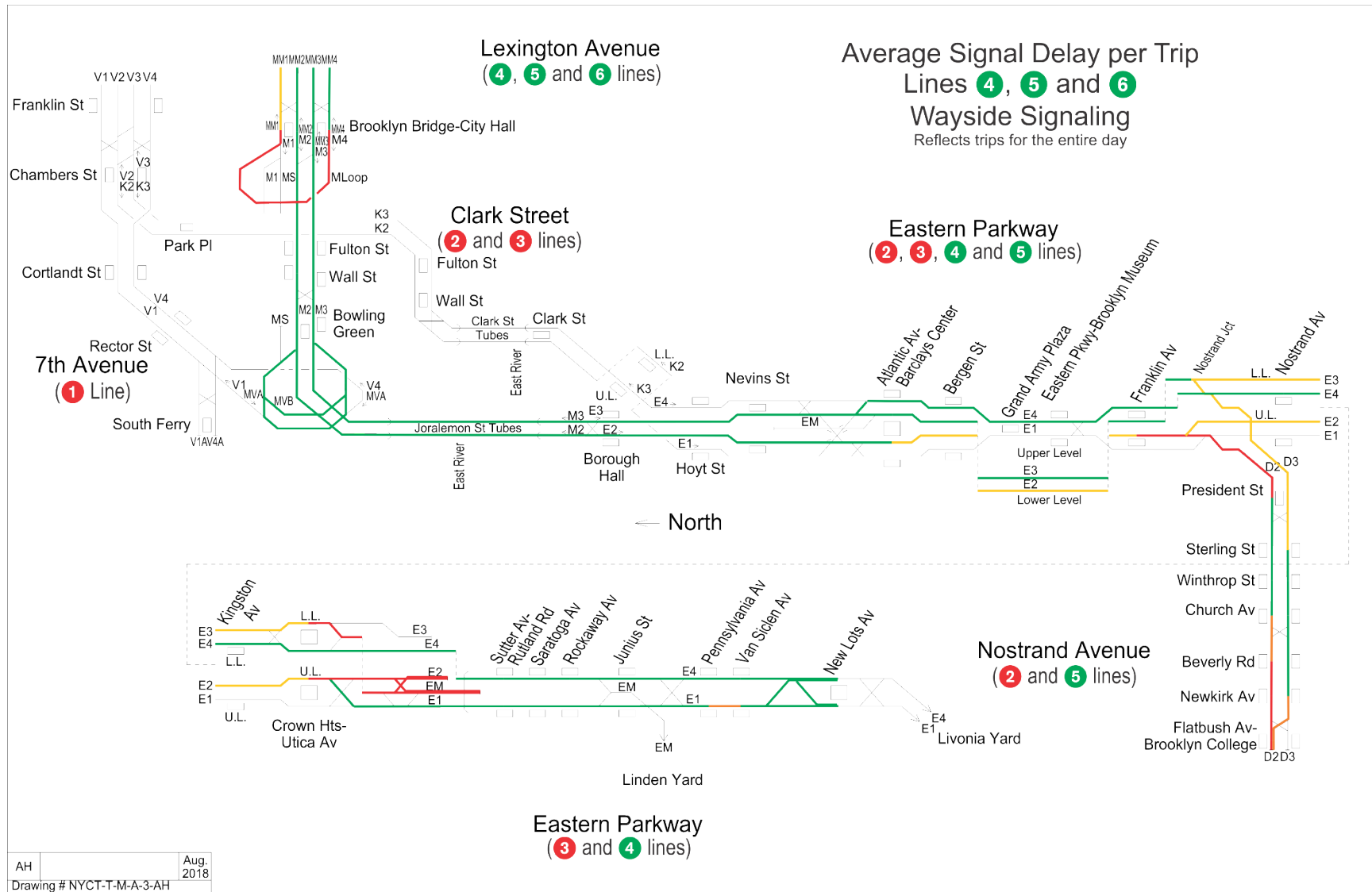


Figure C.3-4: Phase I Schematic highlighting signal delay for 1, 2 and 3 Lines – Future Baseline (CBTC)



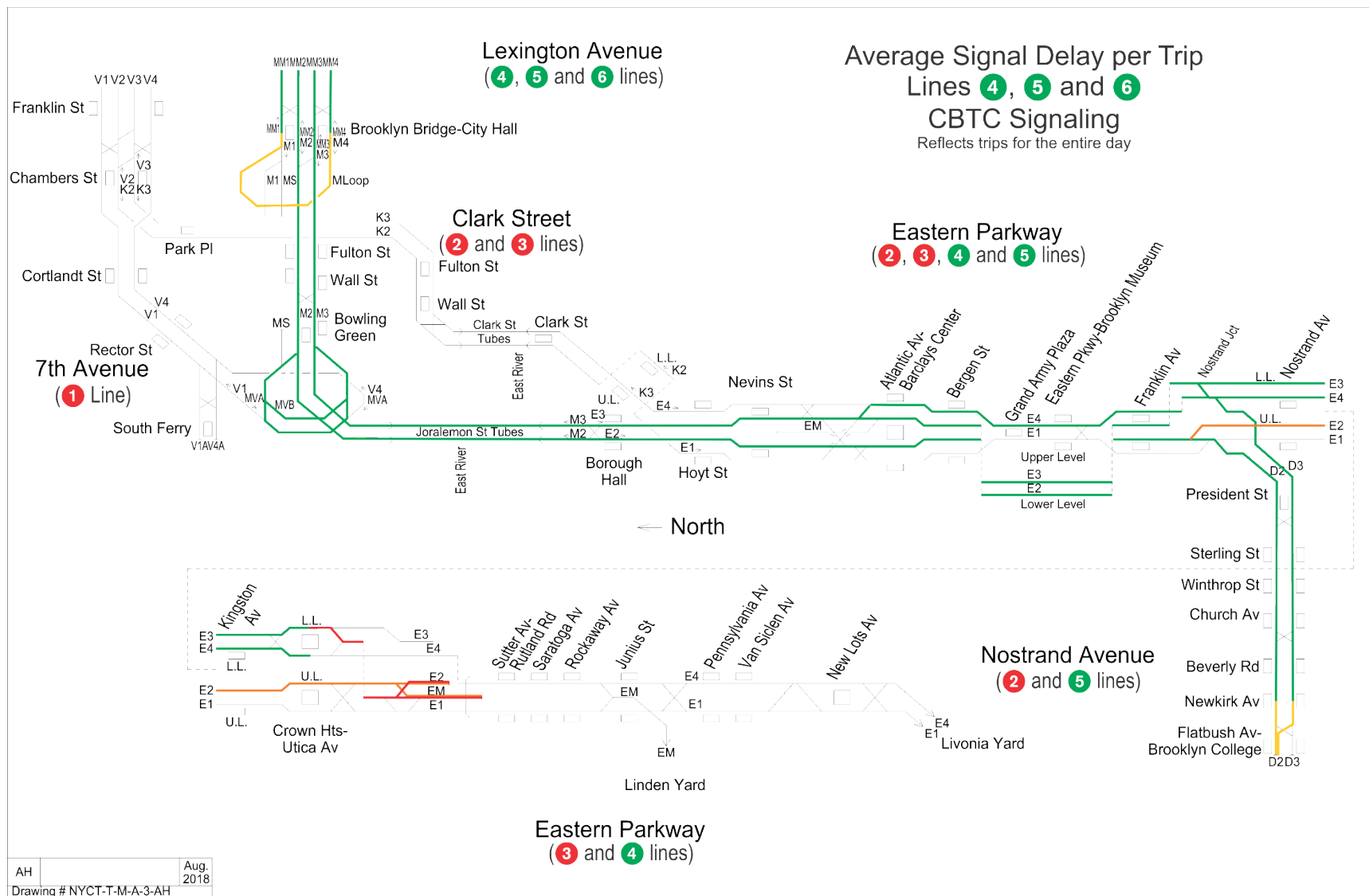
FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure C.3-5: Phase I Schematic highlighting signal delay for the 4, 5 and 6 Lines – Existing Baseline (Wayside)



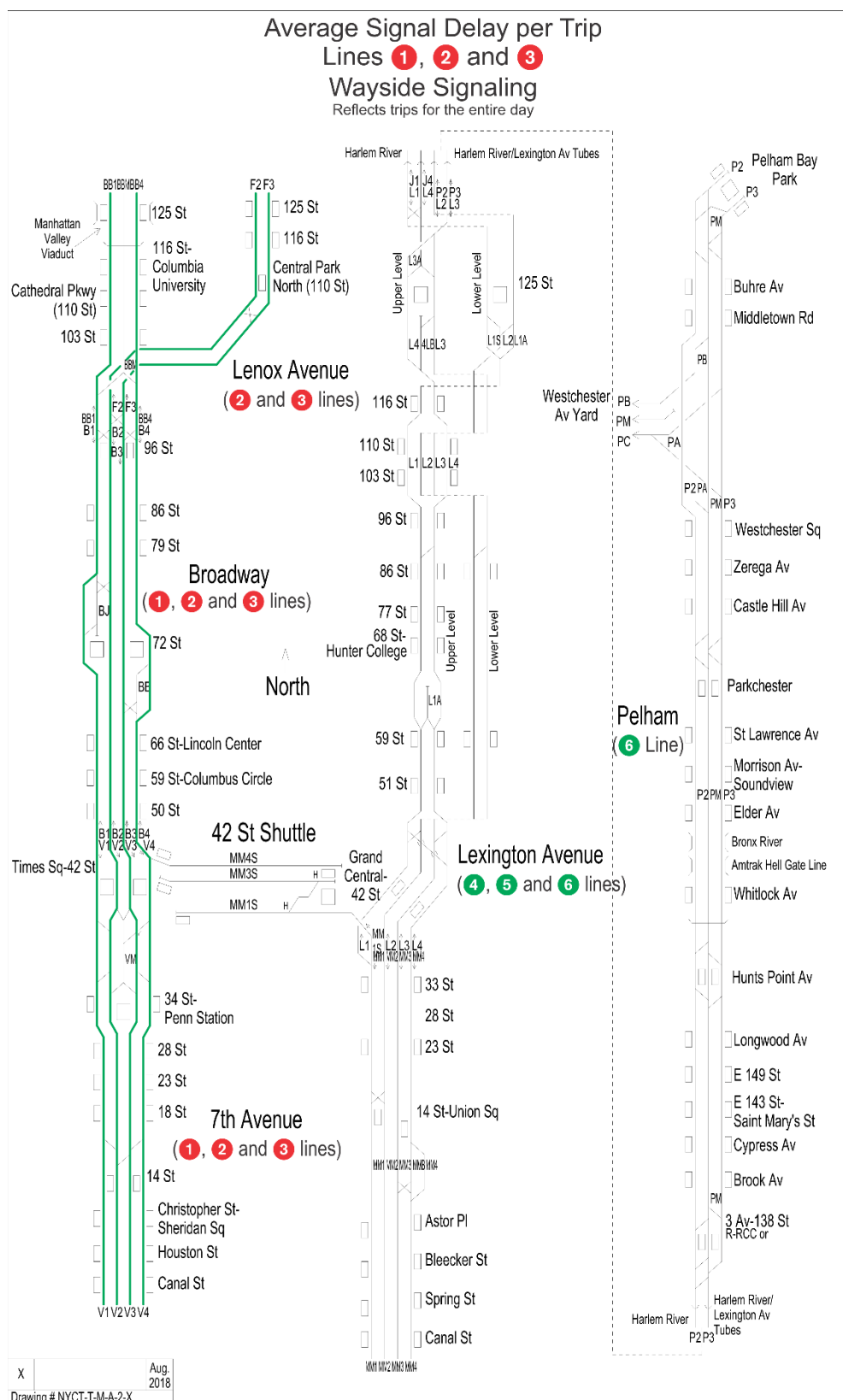
FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure C.3-6: Phase I Schematic highlighting signal delay for the 4, 5 and 6 Lines – Future Baseline (CBTC)



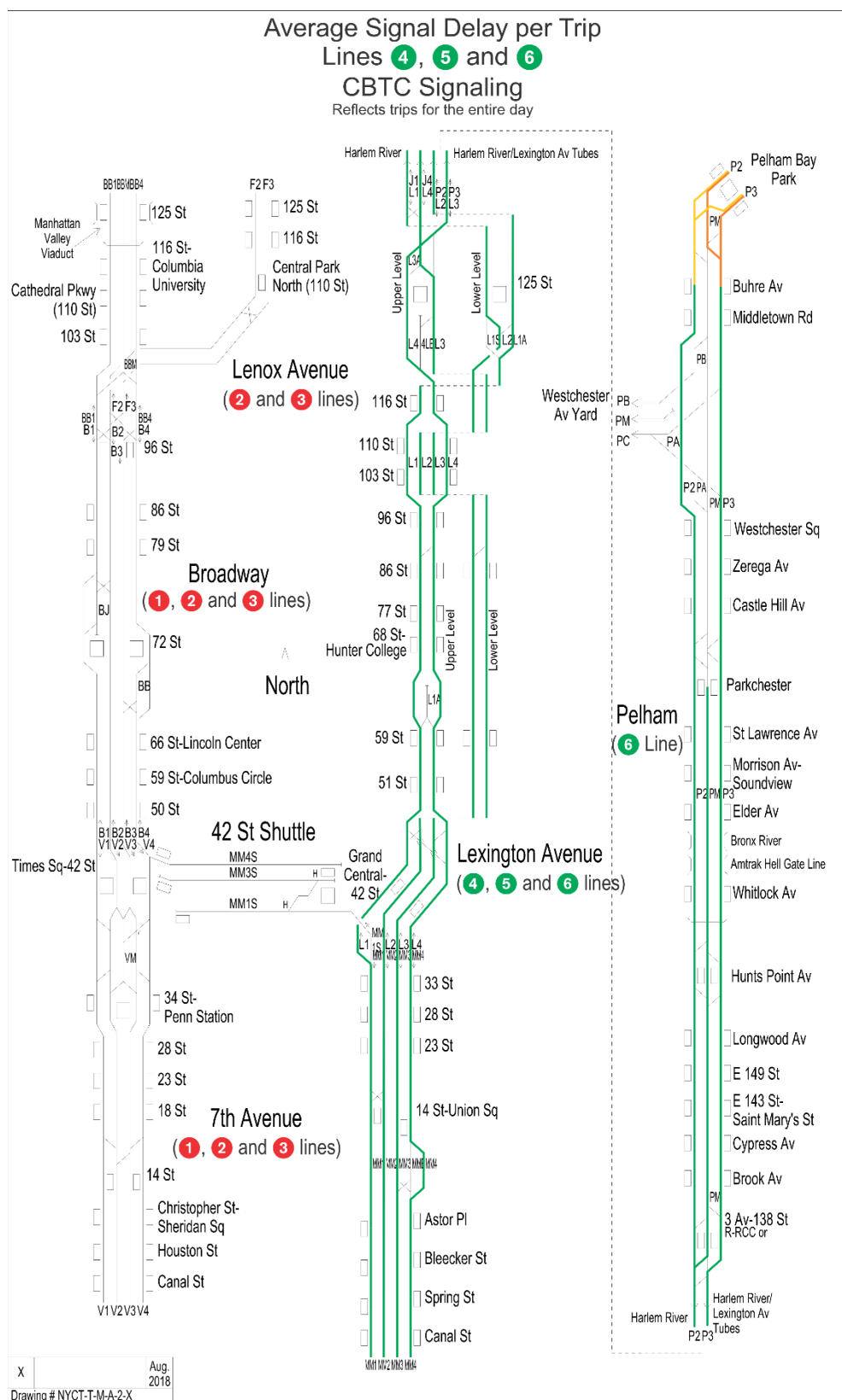
FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure C.3-7: Phase II and III schematic highlighting signal delay for 1, 2 and 3 Lines – Existing Baseline (Wayside)



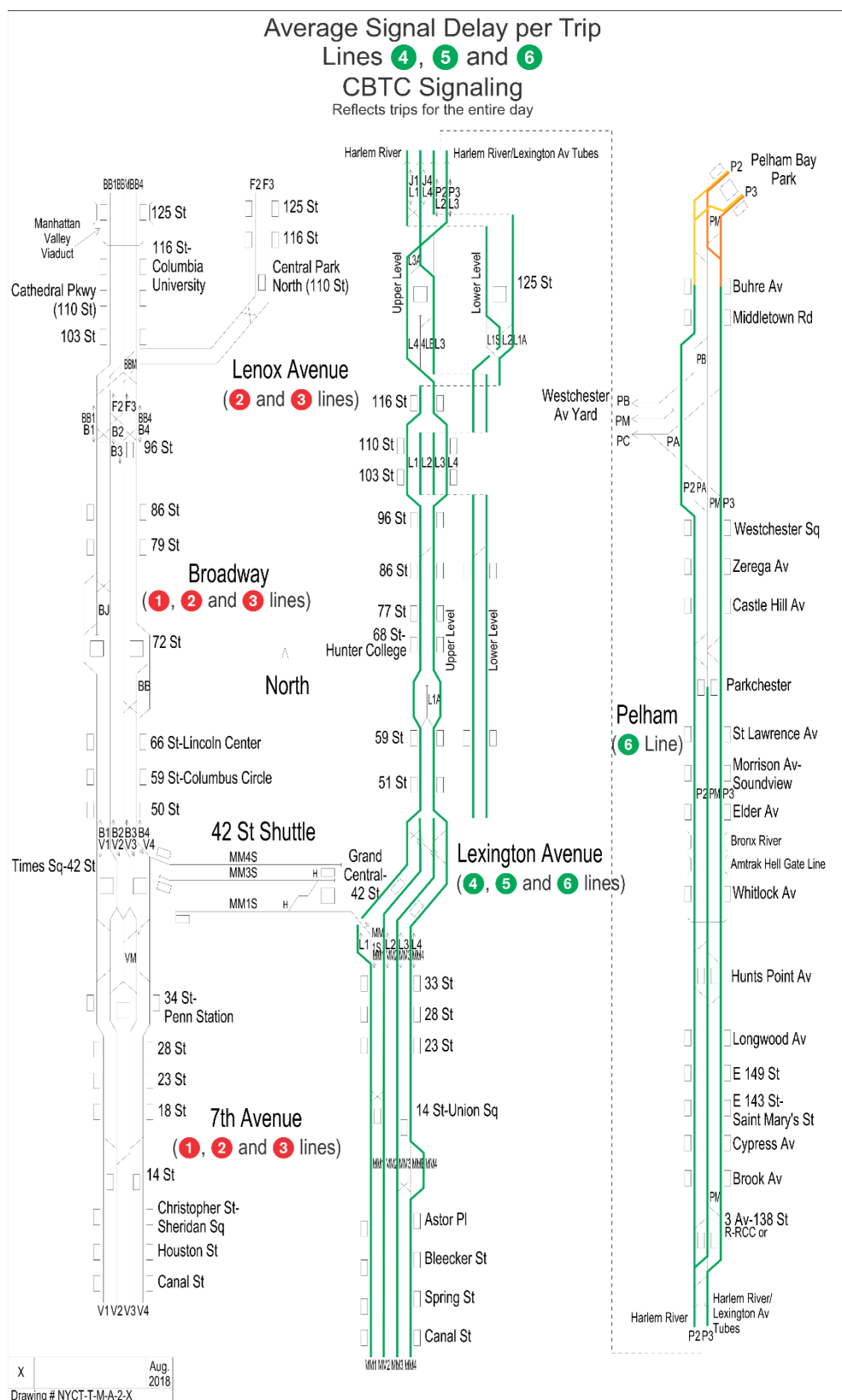
FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure C.3-10: Phase II Schematic highlighting signal delay for the 4, 5 and 6 Lines – Future Baseline (CBTC)



FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure C.3-11: Phase IV schematic highlighting signal delay for 1, 2 and 3 Lines – Existing Baseline (Wayside)



FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure C.3-12: Phase IV Schematic highlighting signal delay for ①, ② and ③ Lines – Future Baseline (CBTC)

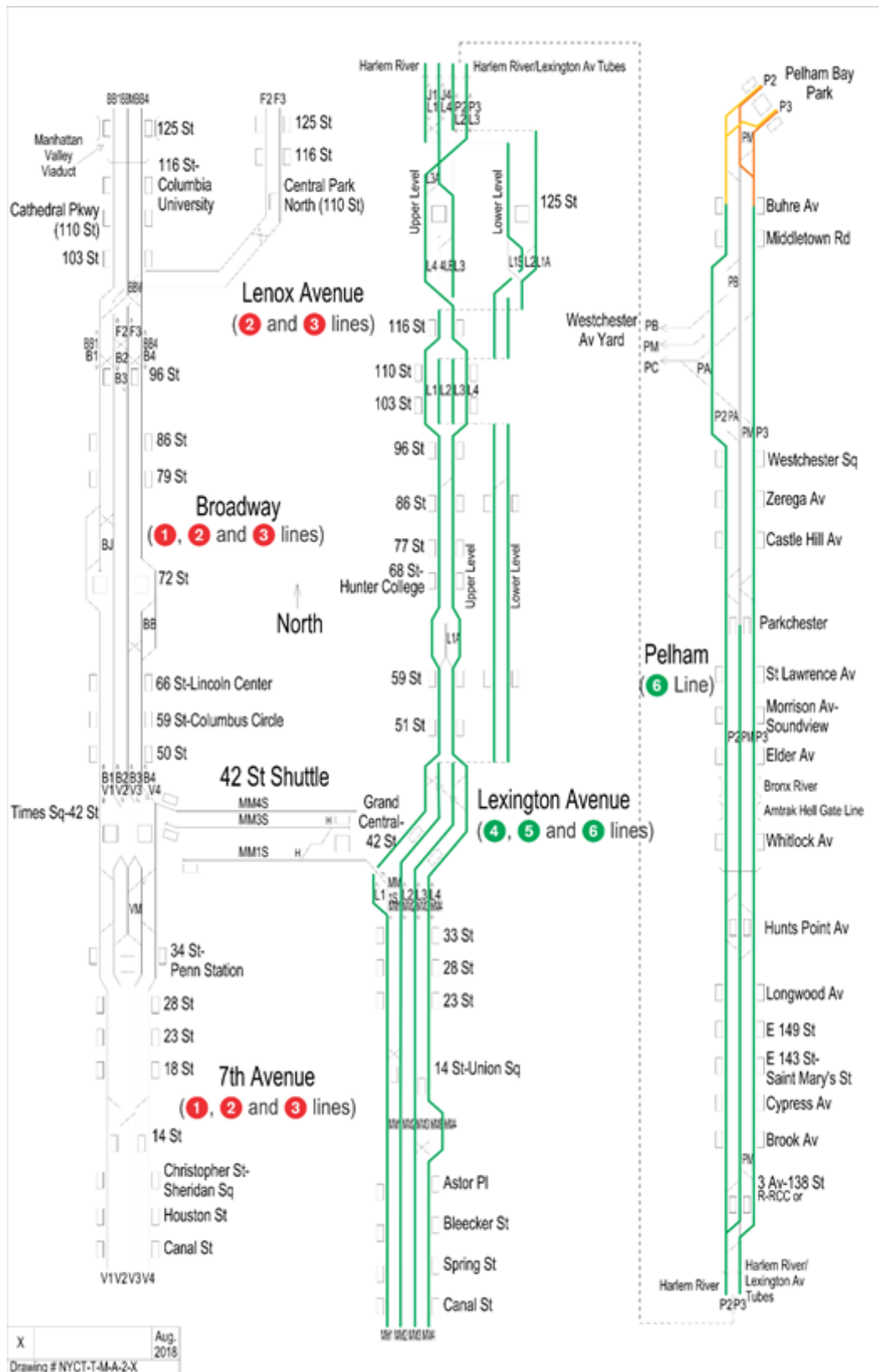


Figure C.3-13: Phase IV schematic highlighting signal delay for the 4, 5 and 6 Lines – Existing Baseline (Wayside)

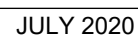


Figure C.3-14: Phase IV schematic highlighting signal delay for the 4 and 5 Lines– Future Baseline (CBTC)



FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

C.3.6 Simulated Terminal Capacity

In order to better understand site-specific capacity constraints, microsimulations were performed for several terminals within the study area under both wayside signaling and CBTC operation. The infrastructure, signaling and vehicles in these microsimulations were taken directly from the validated full network model with no changes. These microsimulations include Phase I (Brooklyn) territory capital improvement concepts developed by the Utica Avenue Corridor Study Team.

In these simulations, batches of 50 trains at a set initial headway were modeled from a nearby station to the terminal and back to the initial station (e.g. from Sterling Street to Flatbush Avenue – Brooklyn College and back). The initial headway was increased (schedule volume of trains reduced for a given time period) for each successive batch until terminal stability was achieved. The actual headway between trains was measured at the initial station (such as at Sterling Street). The headway between trips typically differs as trains travel at different speeds departing the terminal on the straight and diverging routes. The average minimum headway measured corresponds to the maximum theoretical terminal capacity.

Consistent with the network simulations, the following global simulation parameters are reflected in the simulations:

- Schedule margin of 5 percent (wayside signaling) and of 1 percent (CBTC with ATO),
- Capacity utilization ratio: 90 percent (i.e. reported practical terminal capacity is 90 percent of simulated maximum theoretical capacity),
- Route establishment time after release of a route: 12 seconds
- Route release time after train clears opposing interlocking signal: 5 seconds
- Signal-to-signal communication time: 1 second (signals communicate in series)
- Terminal dwell time prior to application of schedule margin: 90 seconds.

The simulated CBTC parameters (e.g. slack protection functionality) are consistent with those applied to the full network simulations.

C.3.6.1 Flatbush Avenue - Brooklyn College

The Flatbush Avenue - Brooklyn College terminal capacity study evaluated two operational scenarios under both wayside and CBTC operation:

- 2 Line and 5 Line services can use either platform
- 2 Line and 5 Line services have dedicated terminal tracks, consistent with current operation (the ratio of 2 Line and 5 Line services was 33:17)

Several infrastructure improvements at the terminal were also evaluated:

- Replacement of the existing #8 standard turnouts north of the terminal with #10 tangential turnouts, facilitating an increase in diverging speeds from 15 MPH to 26.5 MPH (25 MPH in practice);

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- A 77-foot southward track extension beyond the existing platform, improving platform entry speed; and
- Combined crossover and track extension improvements.

Table C.3-18. Flatbush Avenue-Brooklyn College Terminal Capacity

	Services can use either platform		Assigned platforms for 2 and 5 services	
	Average Simulated Headway (MM:SS)	Practical Terminal Capacity (Trains per Hour)	Average Simulated Headway (MM:SS)	Practical Terminal Capacity (Trains per Hour)
Current layout (wayside signaling)	2:45	21	3:12	18
Current layout (CBTC)	1:54	31	2:22	25
Phase 1 tail tracks only (CBTC)	1:50	32	2:17	26
Phase 1 crossover only (CBTC)	1:45	34	2:14	26
Phase 1 – both improvements (CBTC)	1:42	35	2:10	27

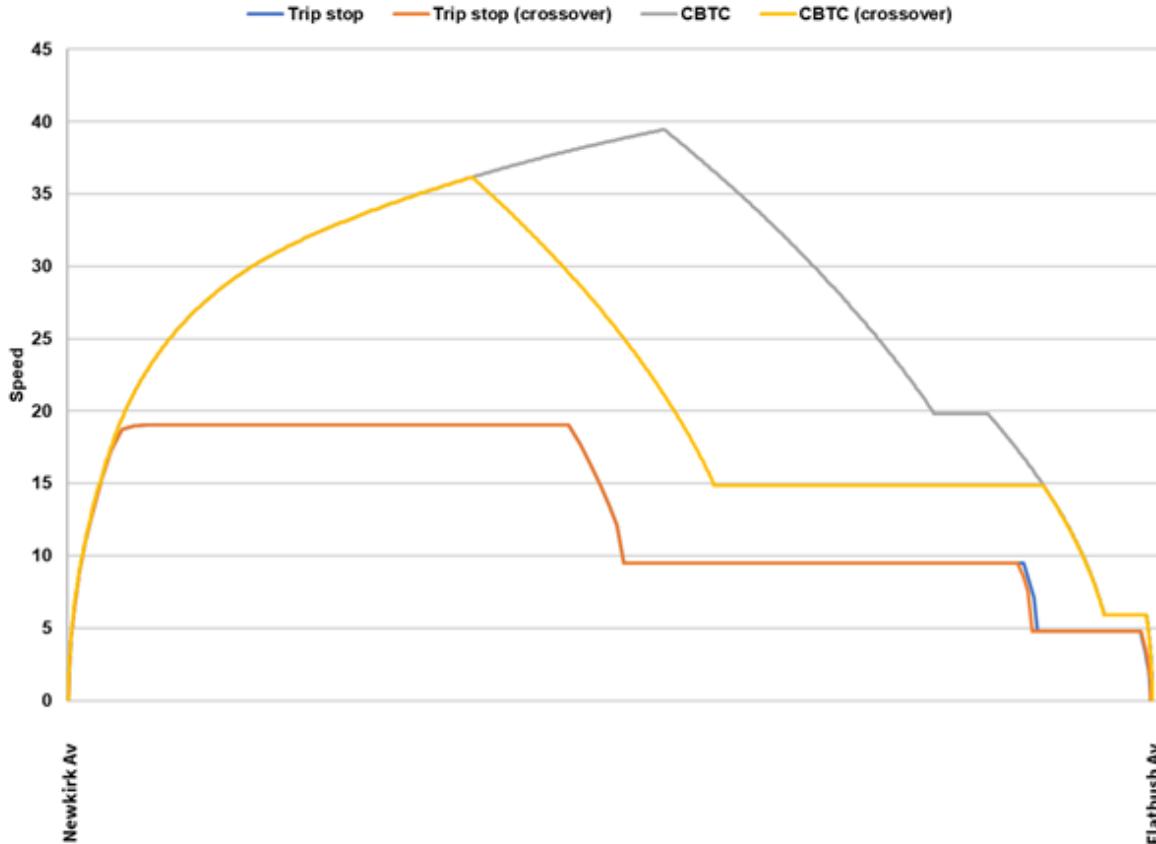
As shown in Table C.3-18, the closer train spacing and higher speeds possible with CBTC significantly increase terminal capacity. However, as trains depart the terminal at different speeds along the straight and diverging routes, regular interval services are not possible at this headway. For southbound (arriving) trains at the headway given in the table, northbound (departing) train headways alternate between:

- Wayside – 2:03 and 3:27
- CBTC – 1:28 and 2:19

Under CBTC ATO operation, it will be possible to “smooth” these headways to the reported 1:54 (or another target headway) through minor enforced dwell time adjustments north of Flatbush Avenue - Brooklyn College and south of Nostrand Junction.

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Figure C.3-15: Simulated southbound velocity profiles entering Flatbush Avenue under wayside signaling and CBTC (no terminal congestion)



C.3.6.2 Crown Heights - Utica Avenue

At Crown Heights - Utica Avenue, the 4 Line relay operation was evaluated in terms of overall terminal capacity. Local track operation of the New Lots Avenue Line was excluded from the terminal capacity study. With wayside signaling, no partial berthing of station is allowed (per NYCT operating rules), even though the ST cutback at signal 3092/E allows trains to partly enter Utica Avenue platform with train ahead waiting at signal 3212/E.

The simulation was based on a Track M berthing location with the south end of the train aligned at the tunnel portal (335+00), rather than pulling to the end of Track M. Under CBTC, the maximum speed on Tracks 2 and M beyond Sutter Avenue Interlocking was assumed to be 20 mph though higher speeds may be possible (NYCT MOW Engineering did not provide specific CBTC design speeds for these non-revenue tracks). Track 2 appears to be straight and could support higher speeds geometrically while Track M curves to follow mainline Track 1, which has a CBTC speed of 37 mph.

Previous NYCT communication stated that switches 549, 561A/B and 563A/B are #10 switches. Under CBTC, these support a diverging speed of 19 MPH.

Slack protection was added to platforms, tail tracks and the tracks between Utica Avenue and Sutter Avenue Interlockings. A critical finding of the analysis is that the slack protection

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implemented for Sutter Avenue interlocking must allow southbound trains to stop between these interlockings, without blocking either, to achieve the resultant simulated capacity.

Table C.3-19 displays the simulated terminal capacity under existing wayside signaling and under CBTC. Capacity was found to be sensitive to the assumed Utica Avenue station dwell; both 40 and 60 second dwells were tested. NYCT does not “sweep” trains at this location and the 40 second dwell is deemed enough for all passengers to alight trains going out of service during peak period.

Table C.3-19. Crown Heights -Utica Avenue Terminal Capacity

Scenario	Average Simulated Headway (MM:SS)	Practical Terminal Capacity (Trains per Hour)
Existing Baseline (Wayside) – 60s Southbound Dwell	3:21	17
Existing Baseline (Wayside) – 40s Southbound Dwell	3:17	18
Future Baseline (CBTC) – 60s Southbound Dwell	2:12	27
Future Baseline (CBTC) – 40s Southbound Dwell	1:51	32

As with the Flatbush Avenue - Brooklyn College terminal capacity evaluation, the closer train spacing and higher speeds possible with CBTC significantly increase terminal capacity. Uniform headway services departing Crown Heights - Utica Avenue can be obtained by increasing some of the northbound dwell times at the Crown Heights - Utica Avenue platform without degrading terminal capacity.

C.3.6.3 *New Lots Avenue*

The New Lots Avenue terminal operation is similar to Flatbush Avenue - Brooklyn College except that only one service (the 3 Line) normally operates to New Lots Avenue and the terminal operation is complicated by train put-ins and pull-outs to and from the yard. As with the other site-specific terminal operations, the analysis found that the closer train spacing and higher speeds possible with CBTC will provide an increase in terminal capacity in the future.

The terminal capacity study at New Lots Avenue also evaluated capital improvements entailing replacement of the #6 AREMA universal crossover with a #10 tangential diamond crossover. This would improve diverging movement speeds from 11 MPH to 26.5 MPH (10 MPH to 25 MPH in practice). The interlocking would therefore be converted from a staggered universal interlocking to a diamond crossover interlocking. Refer to Table C.3-20.

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Table C.3-20. New Lots Avenue Terminal Capacity

Scenario	Average Simulated Headway (MM:SS)	Practical Terminal Capacity (Trains per Hour)
Existing Baseline (Wayside) – Revenue Turns Only	3:13	18
Existing Baseline (Wayside) – Revenue Turns and 6 TPH Yard Put-Ins	3:14	12 Revenue Turn + 6 Yard Put-In
Future Baseline (CBTC) – Revenue Turns Only	2:24	23
Future Baseline (CBTC) – Revenue Turns and 6 TPH Yard Put-Ins	2:28	18 Revenue Turn + 6 Yard Put-In
Future Baseline + Improvement (CBTC) – Revenue Trains Only	1:51	32
Future Baseline + Improvement (CBTC) – Revenue Turns and 6 TPH Yard Put-Ins	2:18	20 Revenue Turn + 6 Yard Put-In

The analysis found somewhat lower capacities at New Lots Avenue versus Flatbush Avenue - Brooklyn College due to a longer New Lots Avenue North (revenue operation side) interlocking with lower diverging speeds. As with the other site-specific terminal capacity analyses, regular interval (uniform headway) departures are not possible at the train volumes shown in Table C.3-20, due to conflicts and dissimilar travel times at New Lots Avenue North Interlocking. If uniform headway departures from New Lots Avenue are required, NYCT would need to reduce the number of trains or increase dwell at other stations north of New Lots Avenue for some trips to regulate headway.

The simulated interaction of turning trains and yard put-ins at New Lots Avenue under both wayside signaling and CBTC shows that the maximum capacity is sensitive to platform assignments at New Lots Avenue, and train priorities at New Lots Avenue North Interlocking. Unlike Flatbush Avenue/Brooklyn College and Crown Heights - Utica Avenue, first-come first-served dispatch priority does not always produce optimal capacity at New Lots Avenue. Instead, the optimum train order must take account of the number and timing (including station dwell time) of trains coming from Livonia Yard in relation to trains already in service.

For the site-specific CBTC simulations, slack protection at New Lots Avenue station was based on the New Lots Avenue South Interlocking home signals being at Stop. No Movement Authority Limits beyond the interlocking was assumed. If tracks beyond the station can be used in determining CBTC Movement Authority Limits, a small reduction in headway is possible. For the revenue turns only scenario with CBTC, this would increase terminal capacity from 23 TPH to 24 TPH.

C.3.6.4 Harlem - 148 Street

The Harlem - 148 Street terminal experiences significant constraints due to mixing revenue trains and yard moves. The terminal capacity analysis evaluated operation under both wayside signaling and CBTC under the following operational scenarios:

- Revenue 3 Line turns only
- 50 percent Revenue 3 Line turns + 50% non-revenue trains from Lenox Yard, which reverse near 145 Street and enter service at 148 Street

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The terminal capacity analysis (Table C.3-21) does not account for the 142 Street flat junction for the diverging 2 line. The effects of the flat junction on capacity are reflected in the full network simulation results.

Table C.3-21. Harlem - 148 Street Terminal Capacity

Scenario	Average Simulated Headway (MM:SS)	Practical Terminal Capacity (Trains per Hour)
Existing Baseline (Wayside) – Revenue Turns Only	3:22	17
Existing Baseline (Wayside) – 50% Revenue Turns/50% Yard Put-Ins	4:21	13
Future Baseline (CBTC) – Revenue Turns Only	2:29	24
Future Baseline (CBTC) – 50% Revenue Turns/50% Yard Put-Ins	3:42	16

The analysis found that the operational scenarios that require turning yard put-ins on the revenue tracks near 145 Street consumes significant capacity under both wayside and CBTC operation. To reduce terminal congestion, trips could alternatively travel to and from the yard directly from 145 Street without serving the terminal. However, as the station platform can only berth 5 cars, a northbound 3 train would not be able to discharge passengers on the rear end of the train.

C.3.6.5 Wakefield - 241 Street

The Wakefield - 241 Street terminal also experiences significant constraints due to mixing revenue trains and yard moves. A visible oscillation in train headways is observed in real-world operation between trains that are operating from the terminal (fast move) and trains that are operating from 239 Street yard (10 MPH move). Train insertions from the yard are therefore difficult to manage and can cause irregular headways.

The terminal capacity analysis (Table C.3-22) evaluated operation under both wayside signaling and CBTC under the following operational scenarios:

- Revenue 2 Line turns only with no put-ins or lay-ups from 239 Street Yard.
- 50 percent of trains make revenue turns at 241 Street while the other 50 percent are trains from 239 Street yard that reverse direction at Nereid Avenue and travel back to 241 Street.
- 50 percent of trains make revenue turns at 241 Street and the other 50 percent are trains to 239 Street Yard that reverse direction at Nereid Avenue (from 241 Street) and travel back to the yard.
- 50 percent of trains traveling north from Nereid Avenue go directly to the yard (with a 30 second dwell to allow for train sweeping) while the other 50 percent operate to 241 Street and make revenue turns.
- 50 percent of trains traveling north from Nereid Avenue go directly to the yard (with a 90 second dwell to allow for train sweeping) while the other 50 percent operate to 241 Street and make revenue turns.

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- 50 percent of the trains operating south from Nereid Avenue come directly from the yard while the other 50 percent operate from 241 Street having made revenue turns.

During the analysis, all revenue services were routed on the outer tracks (W2 and W3) serving all stations. The center track (WM) was only used for turning non-revenue services heading to and from 239 Street Yard.

Table C.3-22. Wakefield - 241 Street Terminal Capacity

	Wayside signaling		CBTC signaling	
	Average Simulated Headway (MM:SS)	Practical Terminal Capacity (Trains per Hour)	Average Simulated Headway (MM:SS)	Practical Terminal Capacity (Trains per Hour)
Revenue services only	2:39	22	2:16	26
Revenue services, put-ins to 241 Street	2:52	20	2:50	21
Revenue services, lay-ups from 241 st Street	3:02	19	2:29	24
Revenue services, lay-ups from Nereid Avenue (with 30s dwell for yard trains)	2:36	23	1:45	34
Revenue services, lay-ups from Nereid Avenue (with 90s dwell for yard trains)	3:14	18	2:15	26
Revenue services, put-ins to Nereid Avenue	2:25	24	2:05	28

The analysis found that the terminal capacity is relatively consistent across all scenarios under wayside signaling. The terminal has the highest capacity when exclusively handling revenue moves; the extra time required for yard moves to traverse the interlocking to and from the platforms slightly reduces capacity. Yard moves that start and end at Nereid Avenue allow slightly more trains to be run overall, as they bypass this constraint.

The capacity increase with CBTC operation varies by scenario. For the scenario with yard put-ins to 241 Street, the time required for trains to travel from the yard to the reversal point and then back to the platform is almost as much of a constraint as wayside signaling. CBTC yields a higher capacity under the scenario with yard lay-ups from 241 Street, as these trips occupy the interlockings for less time than put-ins. The scenario with yard lay-ups from Nereid Avenue yields even higher capacity under CBTC, as these trips occupy the interlockings for much less time than put-ins.

Conceptual engineering was performed to evaluate the feasibility of constructing a new yard lead track providing a direct connection between Wakefield - 241 Street terminal and 239 Street Yard. Construction of a new island platform and track at Nereid Avenue facilitating put-ins and lay-ups directly to and from the yard was also evaluated. Additional detail is included in Section D.1.4.

C.3.6.6 Van Cortlandt Park - 242 Street

The Van Cortlandt Park - 242 Street terminal experiences significant constraints due to mixing revenue trains and moves from 240 Street Yard. The terminal capacity analysis

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(Table C.3-23) evaluated operation under both trip stop and CBTC operation under the following operational scenarios:

- Revenue ① Line turns only with no put-ins or lay-ups from 240 Street Yard
- 50% revenue ① Line turns and 50 percent yard trips to and from 240 Street Yard

Table C.3-23. Van Cortlandt Park - 242 Street Terminal Capacity

Scenario	Average Simulated Headway (MM:SS)	Practical Terminal Capacity (Trains per Hour)
Existing Baseline (Wayside) – Revenue Turns Only	3:01	19
Existing Baseline (Wayside) – 50% Revenue Turns/50% Yard Put-Ins	3:33	16
Future Baseline (CBTC) – Revenue Turns Only	2:06	28
Future Baseline (CBTC) – 50% Revenue Turns/50% Yard Put-Ins	2:43	22

The analysis found that the operational scenarios which require turning yard put-ins and lay-ups consume significant capacity under both wayside and CBTC operation. Conceptual engineering was performed to evaluate the feasibility of constructing a new yard lead track providing a direct connection between Van Cortlandt Park - 242 Street terminal and 240 Street Yard. Additional detail is included in Section D.1.4 of this report.

C.3.6.7 Woodlawn

The Woodlawn terminal capacity analysis (Table C.3-24) evaluated operation under both wayside signaling and CBTC under the following operational scenarios:

- Revenue ④ Line turns only with no put-ins or lay-ups from Jerome Yard; and
- 50 percent revenue ④ Line turns and 50 percent yard trips to and from Jerome Yard.

Table C.3-24. Woodlawn Terminal Capacity

Scenario	Average Simulated Headway (MM:SS)	Practical Terminal Capacity (Trains per Hour)
Existing Baseline (Wayside) – Revenue Turns Only	3:22	17
Existing Baseline (Wayside) – 50% Revenue Turns/50% Yard Put-Ins	2:55	20
Future Baseline (CBTC) – Revenue Turns Only	2:13	27
Future Baseline (CBTC) – 50% Revenue Turns/50% Yard Put-Ins	2:18	26

The analysis found that the operational scenarios which require turning yard trips do not present as significant of a capacity constraint as observed at other terminals such as Harlem - 148 Street.

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C.3.6.8 Eastchester - Dyre Avenue

The Eastchester - Dyre Avenue terminal capacity analysis (Table C.3-25) evaluated operation under both wayside signaling and CBTC with the following results:

Table C.3-25. Eastchester - Dyre Avenue Terminal Capacity

Scenario	Average Simulated Headway (MM:SS)	Practical Terminal Capacity (Trains per Hour)
Existing Baseline (Wayside)	3:07	19
Future Baseline (CBTC)	2:04	29

C.3.6.9 Pelham Bay Park

The Pelham Bay Park terminal capacity analysis (Table C.3-26) evaluated operation under both wayside signaling and CBTC with the following results.

Table C.3-26. Pelham Bay Park Terminal Capacity

Scenario	Average Simulated Headway (MM:SS)	Practical Terminal Capacity (Trains per Hour)
Existing Baseline (Wayside)	2:53	20
Future Baseline (CBTC)	2:07	28

C.3.7 Time-Distance String Charts

Time-distance string charts, shown in Section G.4, were generated from the simulation results for the morning and evening peak periods, distinguishing northbound and southbound trips on separate charts. Because of the complexity of the NYCT network, the tracks are separated into the following geographic territories:

- 138 Street - Grand Concourse to Brooklyn Bridge – City Hall;
- Brooklyn Bridge – City Hall to Nevins Street;
- Nevins Street to New Lots Avenue;
- Nevins Street to Flatbush Avenue - Brooklyn College;
- Pelham Bay Park to 3 Avenue -138 Street;
- Wakefield - 241 Street to 138 Street - Grand Concourse;
- Eastchester - Dyre Avenue to 138 Street - Grand Concourse;
- Woodlawn to 138 Street - Grand Concourse;
- Harlem - 148 Street to Nevins Street; and

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- Van Cortlandt Park - 242 Street to 96 Street.

In all cases, the geographic territory is shown on the vertical axis with north at the top and south at the bottom. Trip plots (“strings”) are shown heading up and to the right for northbound trips and heading down and to the right for southbound trips.

For all geographic territories, 7 Avenue - Broadway Line trips are shown in red, reflecting the ①, ②, and ③ Lines. Lexington Avenue Line trips are shown in green, reflecting the ④, ⑤, and ⑥ Lines. For string charts reflecting exclusively Manhattan territories, trips on the local tracks (the ① and ⑥ Lines) are shown in dark gray so that they can be distinguished from the express trips.

The string charts reflect morning peak periods from 6 a.m. to 10 a.m. and evening peak periods from 3 p.m. to 7 p.m. The individual strings are labeled with the simulated trip ID which is constructed from:

- Service,
- Initial terminal departure time,
- Direction (“N” or “S”).

While horizontal lines generally represent station stops, horizontal lines outside of station locations reflect simulated delays. This can be observed at Bowling Green, for example, where northbound ④ Line trips are held south of the station for ⑤ Line trips using the Battery Park Loop and requesting a route first.

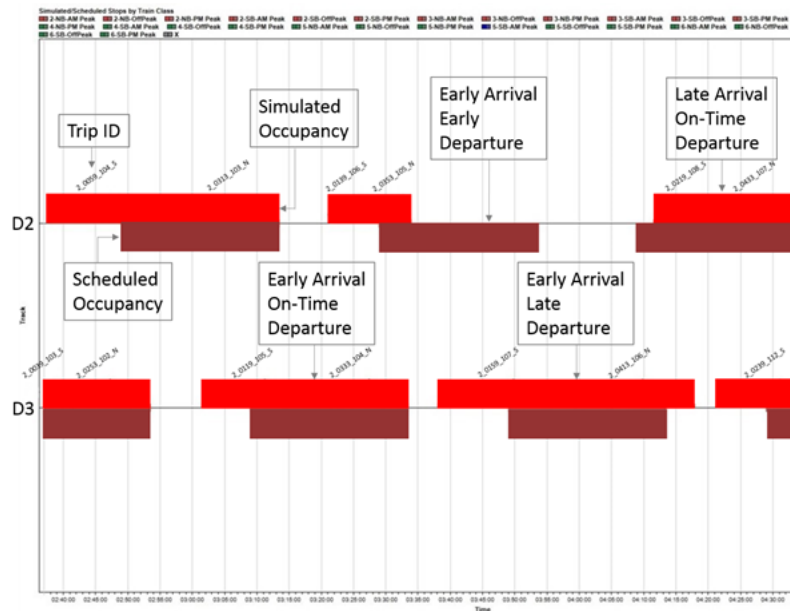
C.3.8 Terminal Station Occupancy Charts

Terminal station occupancy charts are useful in assessing how congested terminals are, determining whether any late dispatches occurred in simulation and evaluating whether the simulated minimum required terminal dwell is sufficiently short to allow for recovery from lateness. As shown in Figure C.3-16, the TrainOps® station occupancy charts show scheduled station occupancy below the reference line corresponding to each station track and actual (simulated) occupancy above the line.

All trains on the ① ② ③ ④ ⑤ ⑥ Lines are assumed to be 10 cars (510 feet) long and berthing is always at the end of platform in the modeling. Intermediate car stop markers are not considered.

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Figure C.3-16: Example of TrainOps® Station Occupancy Chart



Terminal occupancy charts are shown in Section G.5. The occupancies are color-coded using the NYCT standard colors for East Side and West Side A-Division services, with schedule and simulated occupancies shown in slightly different shades. Non-revenue trips such as the X5_0516_249 trip from New Lots Avenue to Flatbush Avenue - Brooklyn College are shown in gray, rather than the red or green revenue service color. Other non-revenue relay or loop moves are also shown in gray, such as the 6 service at Brooklyn Bridge – City Hall and the 4 service at Crown Heights - Utica Avenue.

All trains on the 1 2 3 4 5 6 Lines are assumed to be 10 cars (510 feet) long and berthing is always at the end of platform in the modeling. Intermediate car stop markers are not considered.



IRT CAPACITY STUDY

1 2 3 4 5 6 S LINES

D - CAPACITY SENSITIVITY ANALYSIS TECHNICAL MEMORANDUM



Prepared for:



***by:
STV***

July 2020

CAPACITY SENSITIVITY ANALYSIS

D.0 Revision History – This Section

Revision No.	Date	Description of Revision
0	June 19, 2020	Initial Draft Release
1	July 31, 2020	Final Release

CAPACITY SENSITIVITY ANALYSIS

D.1.1.2 Flatbush Avenue – Brooklyn College

(a) Background

The aim was to measure the maximum capacity of the terminal at Flatbush Avenue - Brooklyn College station, anticipating implementation of CBTC. This is the southern terminus of all 2 Line trains and most weekday 5 Line trains.

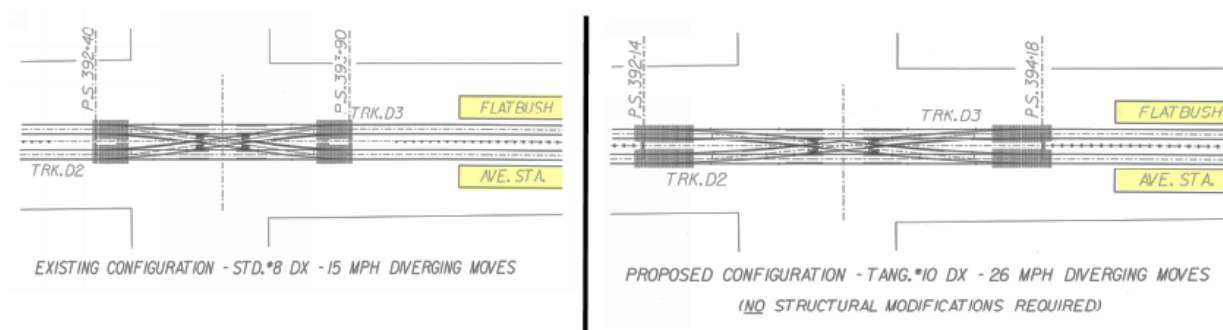
Flatbush Avenue Phase 1 consists of two infrastructure improvements that the STV Team analyzed both individually and together:

- Replacement of the diamond crossover in the station throat to allow higher speeds as shown in Figure D.1-2; and
- 77-foot tail tracks added to both platforms beyond the existing bumper blocks to provide some overrun before the bumper blocks. The existing passage between platforms beyond the existing bumper blocks would be changed to an ADA-compliant underpass. Note that this alternative is one of the two capital

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improvements included in another study for NYCT, the Utica Avenue Transit Improvements Study, whose scope includes development of a future CBTC baseline model.

Figure D.1-2. Replacement of Diamond Crossover, Flatbush Avenue – Brooklyn College



(b) Methodology

The methodology used is the same as previous terminal capacity studies in TrainOps®. The analysis used the validated A-Division simulation model, with CBTC.

Batches of 50 trains at a set initial headway were run from Sterling Street to Flatbush Avenue, and back to Sterling Street. Initial headway was reduced for each successive batch. The actual headway between trains was measured on their return to Sterling Street. This measured headway eventually reached a minimum, regardless of further reductions in initial headway. The average measured minimum headway corresponded to the terminal capacity.

(c) Assumptions

(i) Operating Plans

Two different operating plans were considered:

- All services can use either platform track; and
- ② Line and ⑤ Line services are specifically assigned to their own platform, with a service level of 13 TPH/7 TPH respectively.

Together with the baseline wayside and CBTC cases, this equates to ten different cases analyzed.

(ii) Movement Authority Limit (MAL) to End of Track or Interlocking Home Signal at Stop

NYCT Flushing Line Contract S-32723 RFI #228 (October 19, 2017) addresses this issue due to the configuration at Main Street.

CAPACITY SENSITIVITY ANALYSIS

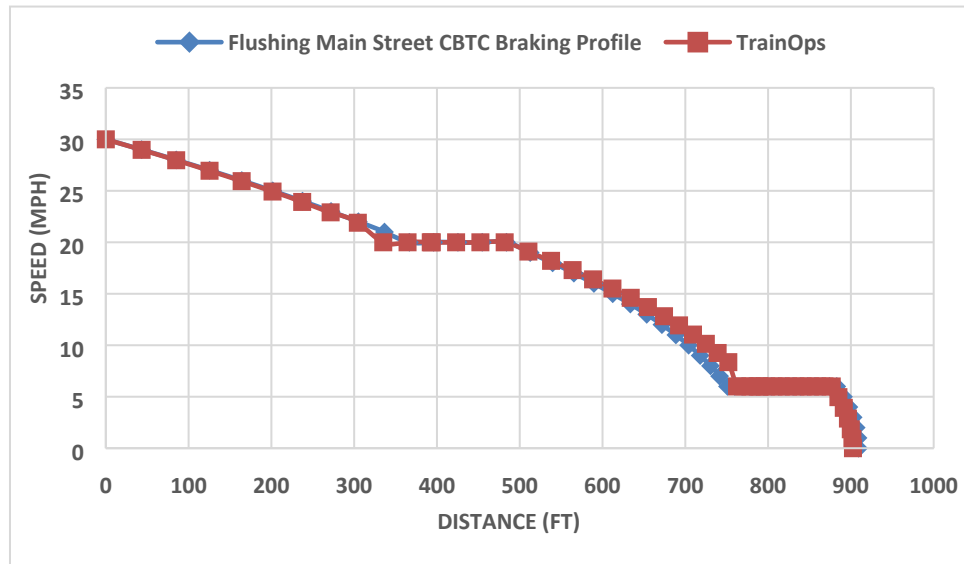
- NYCT directed that the full platform have an enforced 20 MPH limit.
- NYCT directed that the last 113 feet of the platform have a 6 MPH limit.
- NYCT directed that the MAL speed be computed with a 5 MPH target at the bumper.

Slack protection at Flushing Main Street is shown in Figure D.1-3.

(iii) *Microsimulation*

The underlying assumptions of the microsimulation are captured in Table D.1-1.

Figure D.1-3. Slack Protection at Flushing Main Street (7 Line)



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(d) Findings

Table D.1-2. Flatbush Avenue/Brooklyn College Terminal Capacity Study Results

Scenario	Services can use either platform		Assigned platforms for 2 and 5 services	
	Average Simulated Headway (MM:SS)	Trains per hour	Average Simulated Headway (MM:SS)	Trains per hour
Current layout (wayside signaling)	2:45	21	3:12	18
Current layout (CBTC)	1:54	31	2:22	25
Phase 1 tail tracks only (CBTC)	1:50	32	2:17	26
Phase 1 crossover only (CBTC)	1:45	34	2:14	26
Phase 1 improvements (CBTC)	1:42	35	2:10	27

The closer train spacing and higher speeds possible with CBTC significantly increase terminal capacity, as shown in Table D.1-2. CBTC is assumed to target crossover speed restrictions from point of switch to point of switch, rather than through entire interlocking limits.

Regular interval departures are not possible at the headways shown, due to conflicts at the Flatbush Avenue interlocking scissors crossover and the phenomenon of “every other pair of inbound/outbound trains conflict, every other pair of inbound/outbound trains have parallel moves” characteristic of all traditional two-track terminals. Trains depart the terminal with non-uniform headways (typically varying by about 20 seconds) due to different travel times departing on the straight and diverging routes.

(e) Recommendations

The STV Team recommends trains arriving at Flatbush Avenue - Brooklyn College station use whichever track is unoccupied, whether the train is on the 2 Line or 5 Line. NYCT’s passenger information displays show next train departures and the corresponding track, minimizing guesswork by the traveling public. This approach would allow more TPH than pre-assigned platforms and thus greater operational flexibility.

By itself, i.e. not considering the separate Utica Avenue Transit Improvements Study, the marginal improvement in throughput afforded by extending the tail tracks might not justify the capital cost. NYCT clarified that since a train operating under CBTC responds to the distance to the next home signal, adding a runoff track of any length south of Flatbush Avenue would not improve capacity unless the respective home signal at the south end of the platform were moved to the end of the runoff track. Any such design must also provide protection for unequipped trains, i.e. trains with en-route CBTC failures.

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Changing the crossover north of the station, as shown in Figure D.1-2, would afford a significant improvement in throughput and the track and signal changes could be implemented on nights and weekends.

D.1.1.3 Crown Heights - Utica Avenue

(a) Background

The aim was to measure the maximum capacity of the terminal at Crown Heights - Utica Avenue station, anticipating implementation of CBTC. This is the southern terminus of 4 Line trains except on late nights and weekends, except for some rush-hour trains that originate or terminate at New Lots Avenue, and some rush-hour 5 Line trains.

(b) Methodology

Batches of 50 trains at a set initial headway were run on the express tracks from Franklin Avenue to Utica Avenue and back. The initial headway was reduced for each successive batch and the actual headway between trains was measured on their return to Franklin Avenue. This measured headway eventually reached a minimum, regardless of further reductions in initial headway. The average minimum headway measured corresponded to the terminal capacity.

Slack protection was added to platforms, tail tracks and the tracks between Utica Avenue and Sutter Avenue interlockings. The slack protection at Sutter Avenue interlocking must allow southbound trains to stop between these interlockings, without blocking either, to achieve the capacity stated in this report.

(c) Assumptions

All trains were assumed to be express services terminating at Crown Heights - Utica Avenue station. Local track operation of the New Lots line was excluded from this study. With wayside signaling, no partial berthing in a station is allowed, even though Signal Time cutback at signal 3092/E allows trains to partly enter Utica Avenue station with the train ahead waiting at signal 3212/E. Refer to Figure D.1-4.

The assumed berthing location on Track M is at the tunnel portal (335+00). The maximum speed on Tracks 2 and M beyond Sutter Avenue Interlocking was assumed to be 20 MPH. NYCT Maintenance of Way (MOW) Engineering did not provide specific CBTC design speeds for these non-revenue tracks.

Simulated speed assumptions are conservative. The diverging speed of 19 MPH is based on NYCT CBTC criteria.

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(d) *Findings*

Table D.1-3. Utica Avenue Terminal Capacity Results

Scenario	Average Simulated Headway (MM:SS)	Trains per hour
Trip stop (60-second southbound dwell)	3:21	17
Trip stop (40-second southbound dwell)	3:17	18
CBTC (60-second southbound dwell)	2:12	27
CBTC (40-second southbound dwell)	1:51	32

The STV Team noted that the Utica Avenue relay tracks are modeled with 20 MPH CBTC speed limits. This is higher than current operating speed limits but may be lower than the geometry supported by these tracks (the NYCT MOW Engineering CBTC speed profiles do not cover these tracks).

The STV Team also noted that the route establishment time and interlocking route release time are the same between the existing baseline and future CBTC models, at 15 seconds and 5 seconds respectively.

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(e) Recommendations

As with the Flatbush Avenue terminal capacity study, the closer train spacing and higher speeds possible with CBTC significantly increase terminal capacity, as shown in Table D.1-3. Uniform headway services departing Utica Avenue can be obtained by increasing some of the northbound dwell times at the platform without degrading terminal capacity.

Track 2 appears to be straight and could support higher speeds geometrically. Track M curves to follow mainline Track 1, which has a CBTC speed of 37 MPH. NYCT advised that switches 549, 561A/B and 563A/B are #10 switches. Refer to Figure D.1-4.

A careful review of future CBTC signal-to-signal spacing is needed.

D.1.1.4 New Lots Avenue

(a) Background

The aim was to measure the maximum capacity of the terminal at New Lots Avenue station, anticipating implementation of CBTC. This is the southern terminus for all 3 Line trains except late at night, and all late-night and some rush hour 4 Line trains. This station is unusual in NYCT in that the station tracks continue as the yard leads, in this case to Livonia Yard, as shown in Figure D.1-1.

(b) Methodology

Slack protection at New Lots Avenue station was based on the New Lots Avenue south interlocking home signal being at Stop.

(c) Assumptions

If tracks beyond the station can be used as a buffer overrun, a small reduction in headway is possible, enough to increase the capacity to 24 TPH for the “revenue turns only” case.

(d) Findings

Table D.1-4. New Lots Avenue Terminal Capacity Results

Scenario	Average Simulated Headway (MM:SS)	Trains per hour
Trip stop (revenue turns only)	3:13	18
Trip stop (additional yard trains)	3:14	12 + 6
CBTC (revenue turns only)	2:32	23
CBTC (additional yard trains)	2:29	18 + 6

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(e) *Recommendations*

The closer train spacing and higher speeds possible with CBTC will provide an increase in terminal capacity. Regular interval departures are not possible at this headway, due to conflicts at New Lots Avenue north interlocking and the phenomenon of “every other pair of inbound/outbound trains conflict, every other pair of inbound/outbound trains have parallel moves” characteristic of all traditional two-track terminals. Trains depart the terminal with non-uniform headways (typically varying by about 20 seconds) due to different travel times departing on the straight and diverging routes. If uniform dispatch headways are required, the number of trains will need to be reduced, or the dwell increased at other stations north of New Lots Avenue.

D.1.1.5 Nostrand Junction

This study has not evaluated changes to Nostrand Junction. Within the scope of the separate Utica Avenue Transit Improvements Study, two new crossovers at the junction and “straight-railing” operation through the junction are being considered, using the future CBTC baseline model.

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D.1.2 Phase II - Lexington Avenue Line CBTC Analysis

D.1.2.1 Territory Covered

The territory subject of Phase II of this study is the “A” Division Lexington Avenue line, north from Nevins Street station to 149 Street - Grand Concourse station (4 Line) and to 3 Avenue – 149 Street station (5 Line), and from Brooklyn Bridge – City Hall station to 3 Avenue – 138 Street station (6 Line). Phase II is divided into two parts: Phase II-A covering express tracks only, a subset of Phase II-B, which is the whole territory shown in Figure D.1-5.

D.1.2.2 Performance Modeling

The STV Team performed simulations of the 4 Line and 5 Line in both directions between 138 Street – Grand Concourse and Nevins Street, versus event recorder data provided by NYCT from R142 cars. The results of these simulations appear in Section F.2, Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots. In most cases the calibrated simulated speeds between stations were less than the uncalibrated speeds. These data should be analyzed from one pair of stations to the next to determine how running times might be reduced without waiting for the implementation of CBTC in the Phase II territory.

In the course of the study NYCT asked the STV Team how the simulation model makes allowances for varying Train Operator (T/O) adherence to Station Time (ST) and Grade Time (GT) timers, noting that operators are often unable to adhere to the posted speeds.

The STV Team noted that ST timer and control line logic is site-specific and accurately reflected in the model. Trains are profiled towards ST signals at stop and will start accelerating after a brief T/O reaction time if an ST signal upgrades from red to yellow.

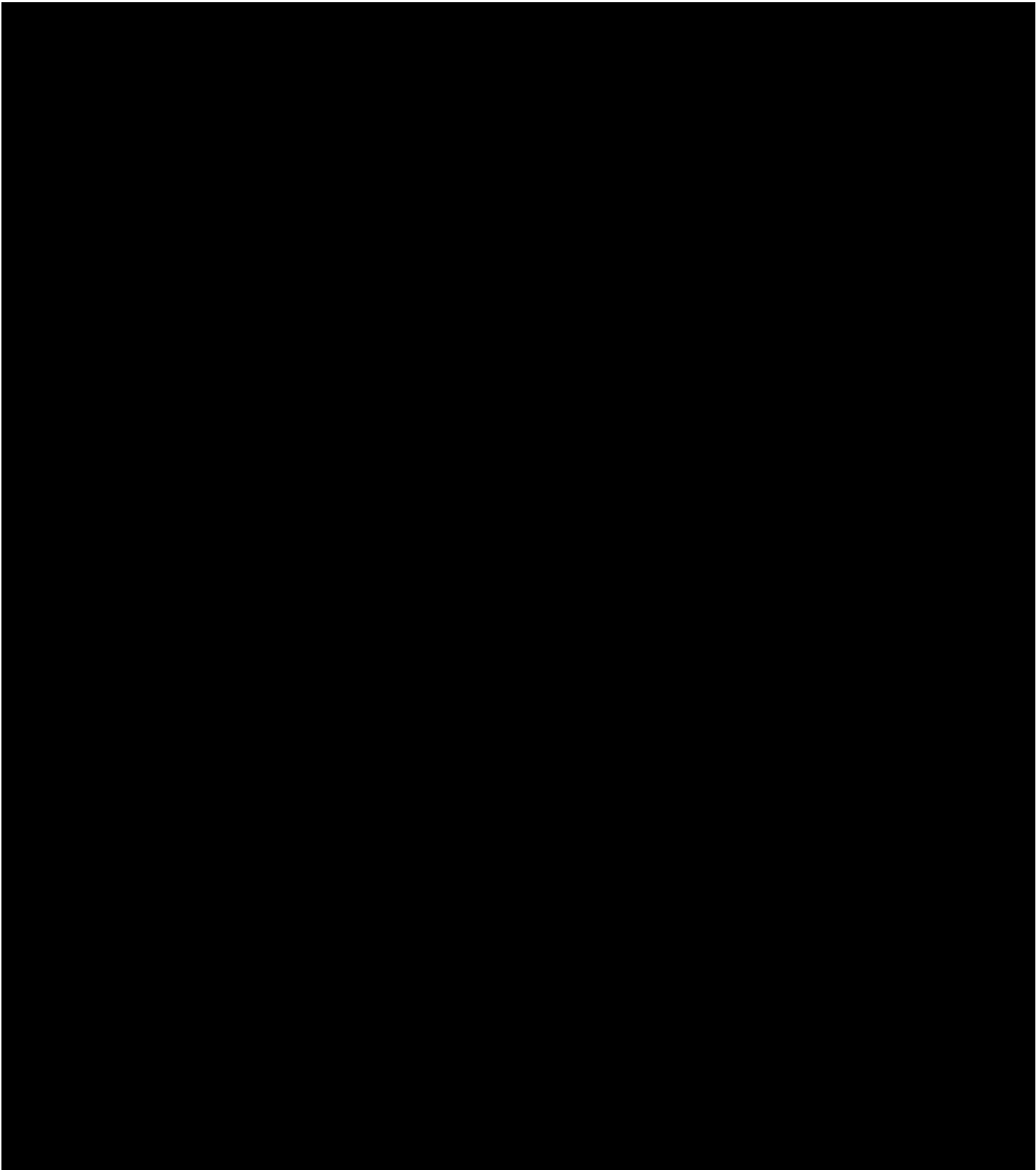
The STV Team noted that GT timer logic is not specifically included in the model, but the speed effects of GT are. NYCT Division of Car Equipment (DCE) Event Recorder data were used to reduce speeds to accurately reflect T/O behavior.

Refer also to the findings on velocity profiles in Paragraph D.1.2.5.

D.1.2.3 Background

The STV Team was assigned the task of evaluating the Lexington Avenue Line to identify the top capacity constraining locations between Bowling Green and 125 Street and to identify conceptual mitigations. The Phase II Lexington Avenue Line was coded and calibrated in the TrainOps® model from Nevins Street to just south of 138 Street, including grades, curves, interlocking limits, and platforms. The analysis focused on the express tracks as the local tracks are much less capacity constrained. Dwell time variability was reviewed for key stations, including Bowling Green, Wall Street, Fulton Street, 14 Street – Union Square (ensuring that the effects of the gap fillers were fully reflected), 42 Street – Grand Central, 59 Street, 86 Street and 125 Street.

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D.1.2.4 Methodology

NYCT suggested that a 32 TPH pass/fail criterion could be used but asked how future Union Square CBTC capacity compares against the many other known capacity “pinch points” along the Lexington Avenue Line. A crush capacity simulation was performed using average dwell times per station and direction with the resulting TPH multiplied by 90 percent in order to account for real world variability. Operations simulation models were prepared for both the existing wayside signaling and future CBTC operations coded with V4 curve speeds between Utica Avenue/Flatbush Avenue and 138 Street. Several “stress test” simulations were run in both directions from Utica Avenue/Flatbush Avenue to 138 Street and vice versa to operate steady-state 36 TPH volumes. The resultant throughput was documented and used to determine which location in each direction most constrains capacity. The most capacity constraining location was then resolved through artificial dwell time improvements to determine the second and third most capacity-constraining locations in each direction.

D.1.2.5 Findings

(a) Velocity Profiles

(i) 4 Line and 5 Line (Express)

Long dwell times were observed at Grand Central and Brooklyn Bridge – City Hall. Extended dwells were also seen at 125 Street, 86 Street and 59 Street. Close station spacing between Fulton Street, Wall Street and Bowling Green constrains speeds on the line. There are no short-turn or other “pressure relief valve” locations between 149 Street – Grand Concourse and the Battery Park Loop.

The model was calibrated by evaluating differences between the simulated CBTC velocity profile and event recorder data from the existing wayside signal system. Refer to Figure D.1-6, Figure D.1-7, Figure D.1-8, and Figure D.1-9. CBTC speed assumptions were modified to reflect potential field conditions identified by the event recorder data that may not have been properly captured in the review and coding of civil data.

In Figure D.1-6 and Figure D.1-7, “Unimpeded” is a simulated train operating on the line independent of other trains. “Impeded” is the model condition under which running time degradations and schedule padding are applied to simulate real-world conditions.

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Figure D.1-6. Simulated CBTC Velocity Profile – Southbound, 138 Street to Nevins Street

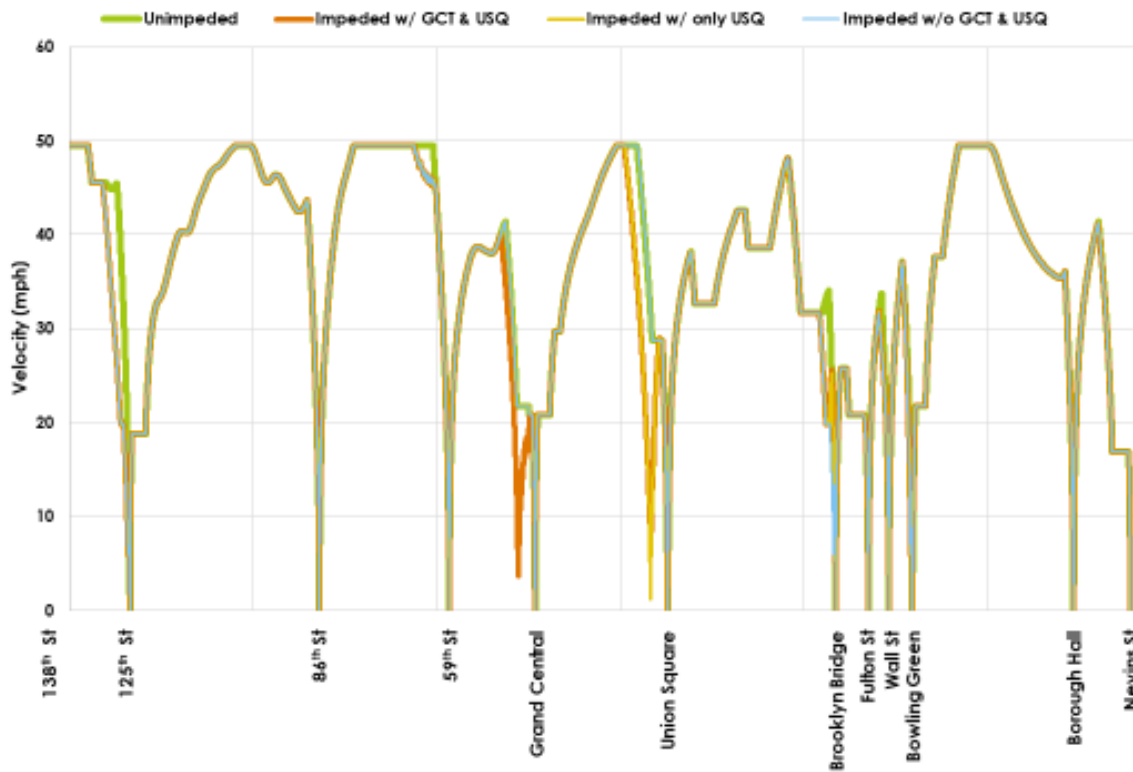
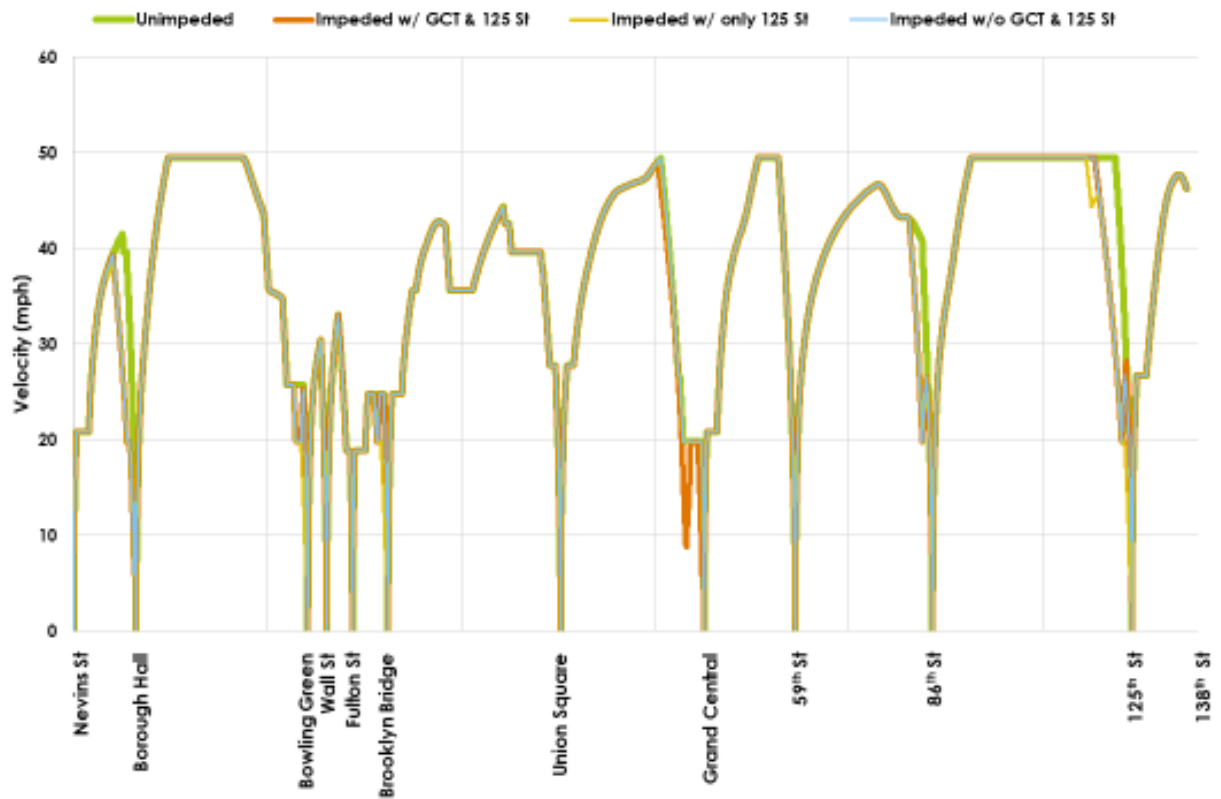


Figure D.1-7. Simulated CBTC Velocity Profile: Northbound, Nevins Street to 138 Street



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Figure D.1-8. Simulated CBTC vs Event Recorder Velocity Profile: Southbound, 138 Street to Bowling Green

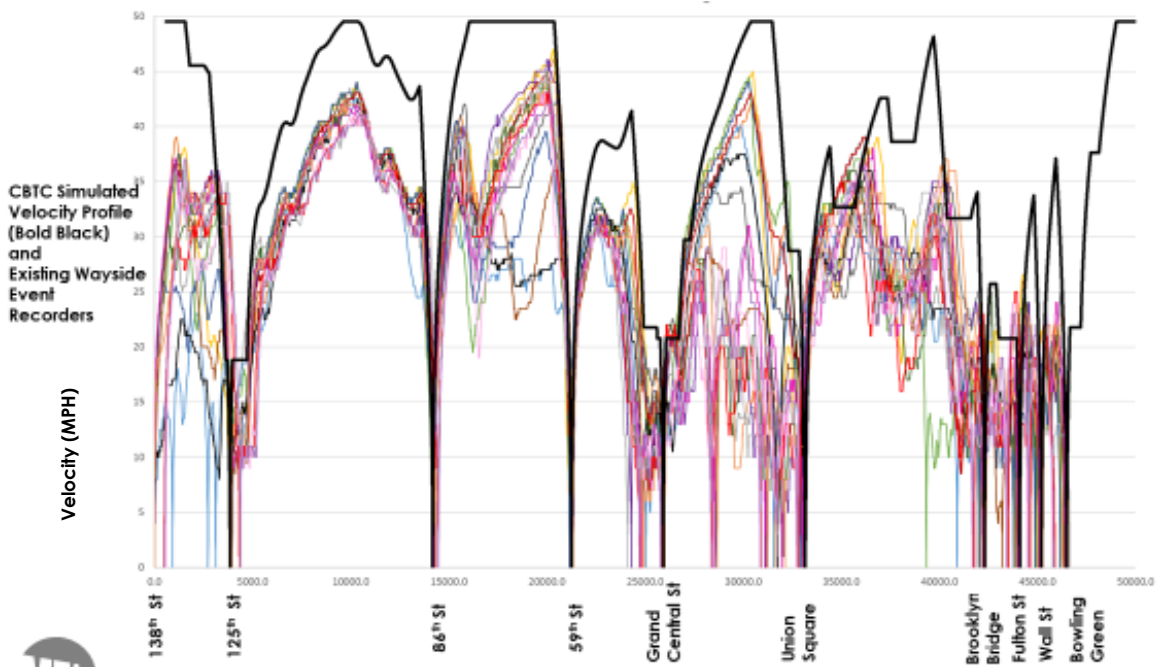
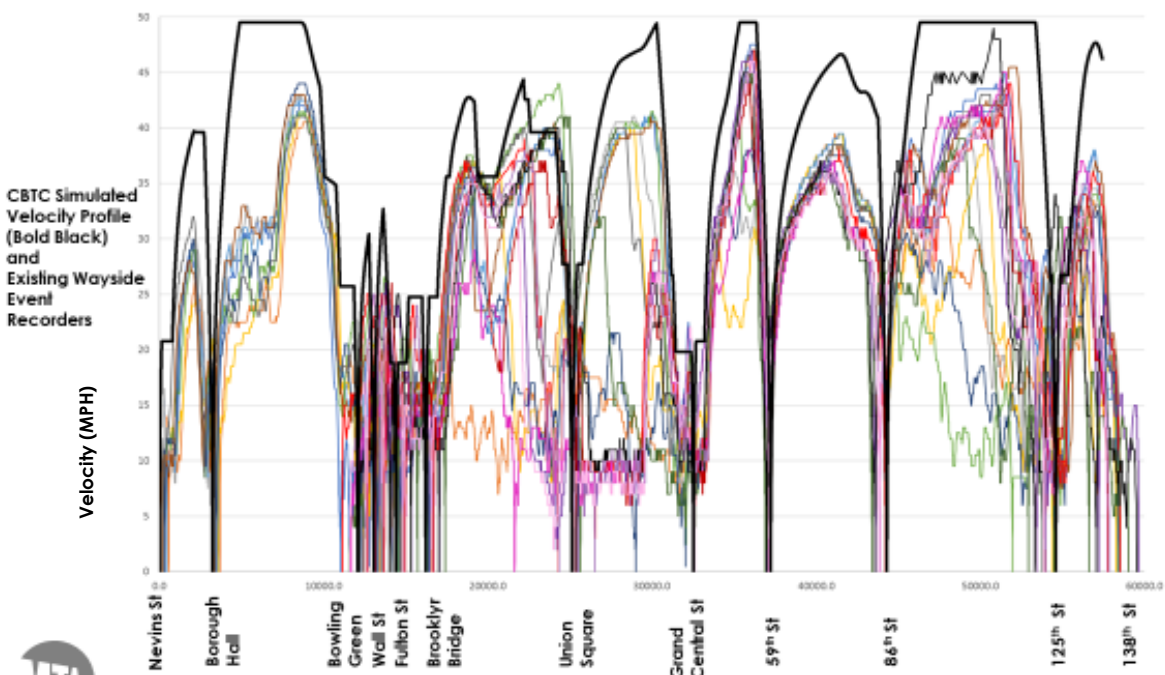


Figure D.1-9. Simulated CBTC vs Event Recorder Velocity Profile – Northbound, Nevins Street to 138 Street



Note that Figure D.1-8 and Figure D.1-9 differ from Figure G.6-7 and Figure G.6-8 in that the latter two graphs show event recorder data, a wayside simulation, and a CBTC simulation together.

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i. 6 Line (Local)

The STV Team presented a velocity profile for the 6 Line traveling northbound between Brooklyn Bridge – City Hall station and 125 Street station.

The STV Team noted that the Train Operators in both event recorder profiles did not appear to adhere to non-GT-enforced speed signs in the following locations: Brooklyn Bridge - City Hall station (19 MPH), Astor Place station (22 MPH), 116 Street station (25 MPH).

Refer to Section D.1.2.5 for the final velocity profiles.

(b) Travel Times

The Simulated CBTC travel times were assessed by inter-station segments in both directions under both unimpeded and impeded conditions. Refer to Table D.1-5 and Table D.1-6. “Unimpeded” and “Impeded” have the same definitions given above for Figure D.1-6 and Figure D.1-7.

Table D.1-5. Summary of Simulated CBTC Travel Time Unimpeded vs Impeded – Northbound

From	To	Unimpeded (MM:SS)	Impeded (MM:SS)
Nevins Street	Borough Hall	01:26	01:40
Borough Hall	Bowling Green	02:44	02:47
Bowling Green	Wall Street	00:37	00:37
Wall Street	Fulton Street	00:48	00:48
Fulton Street	Brooklyn Bridge	01:07	01:08
Brooklyn Bridge	Union Square – 14 Street	03:02	03:02
Union Square – 14 Street	Grand Central – 42 Street	02:40	02:58*
Grand Central – 42 Street	59 Street	01:43	01:43
59 Street	86 Street	02:15	02:21
86 Street	125 Street	02:50	03:00*
-Does not reflect cascading delays			

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Table D.1-6. Summary of Simulated CBTC Travel Time Unimpeded vs Impeded – Southbound

From	To	Unimpeded (MM:SS)	Impeded (MM:SS)
125 Street	86 Street	03:19	03:19
86 Street	59 Street	02:04	02:05
59 Street	Grand Central – 42 Street	01:56	02:18*
Grand Central – 42 Street	Union Square – 14 Street	02:32	02:54
Union Square – 14 Street	Brooklyn Bridge	03:17	03:22
Brooklyn Bridge	Fulton Street	01:06	01:06
Fulton Street	Wall Street	00:39	00:40
Wall Street	Bowling Green	00:43	00:47
Bowling Green	Borough Hall	02:51	02:51
Borough Hall	Nevins Street	01:36	01:36
*-Does not reflect cascading delays			

Simulated CBTC travel time improvements were assessed for various segments by capturing the average and minimum travel times for the existing wayside signal system and comparing to CBTC travel time along with a percent improvement for average and fastest travel times under both unimpeded and impeded conditions. Refer to Table D.1-7. “Unimpeded” and “Impeded” have the same definitions given above for Figure D.1-6 and Figure D.1-7. The summary shows that implementation of CBTC will provide a 15 – 30 percent improvement for average travel times and a 10 – 15 percent improvement for the fastest travel times along the Lexington Avenue Line. The section between 42 Street and 59 Street is projected to see the greatest improvement in average travel times, while the segment between 86 Street and 125 Street will see the greatest improvement in fastest travel times.

In addition to simulated travel times, station occupancy and dwell times were evaluated during the a.m. and p.m. peak periods in both directions and summarized by maximum dwell time. The assessment found that Grand Central in the northbound direction experiences the longest Max Dwells of any station at 55 seconds. The second longest Max Dwells in the northbound direction are experienced at Union Square and 125 Street, at roughly 45 seconds. This evaluation also identified Grand Central and Union Square as having the longest Max Dwell of 50 seconds in the southbound direction, with 125 Street and 59 Street with Max Dwells of roughly 40 seconds. Refer to Table D.1-8 and Table D.1-9.

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Table D.1-7. Summary of Simulated CBTC Travel Time Improvements

Station-Station Pair	Average Wayside Time (MM:SS)	Average Wayside Time (MM:SS)	Unimpeded			Impeded		
			CBTC Time (MM:SS)	Pct Improvement (Average)	Pct Improvement (Average)	CBTC Time (MM:SS)	Pct Improvement (Average)	Pct Improvement (Average)
42 Street to 59 Street	2:26	1:55	1:43	29.5%	10.4%	1:43	29.5%	10.4%
59 Street to 86 Street	2:46	2:37	2:15	18.7%	14.0%	2:21	15.1%	10.2%
125 Street to 86 Street	4:15	3:54	3:19	22.0%	15.0%	3:19	22.0%	15.0%
Union Square to Brooklyn Bridge	4:24	3:48	3:17	25.4%	13.6%	3:22	23.5%	11.4%

Table D.1-8. Median Dwells – Northbound (rounded to nearest 5 seconds)

Station	Track	PM Peak Dwell (seconds)	AM Peak Dwell (seconds)	Max Dwell Used (seconds)
Nevins Street	3	25	30	30
Borough Hall	3	30	35	35
Bowling Green	3	35	35	35
Wall Street	3	30	30	30
Fulton Street	3	35	35	35
Brooklyn Bridge - City Hall	3	30	25	30
14 Street - Union Square	3	45	45	45
Grand Central - 42 Street	3	55	45	55
59 Street	3	35	30	35
86 Street	3	35	30	35
125 Street	3	45	35	45

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Table D.1-9. Median Dwells - Southbound (rounded to nearest 5 seconds)

Station	Track	PM Peak Dwell (seconds)	AM Peak Dwell (seconds)	Max Dwell Used (seconds)
125 Street	2	30	40	40
86 Street	2	30	35	35
59 Street	2	35	40	40
Grand Central - 42 Street	2	45	50	50
14 Street - Union Square	2	50	50	50
Brooklyn Bridge - City Hall	2	30	30	30
Fulton Street	2	35	35	35
Wall Street	2	35	30	35
Bowling Green	2	35	30	35
Borough Hall	2	35	30	35
Nevins Street	2	30	25	30

Additional care was taken to ensure that the effects of the gap fillers at Union Square southbound were accurately captured. The gap filler functionality and speed restriction time-distance charts, Figure D.1-10 and Figure D.1-11, illustrate that the effects on dwell are accurately captured in the event recorder data and that a significant speed restriction is experienced on trains departing the station. The gap filler signal functionality requires that the home signal south of the platform must be triggered, but that train speeds are limited to 5 MPH until the gap fillers are retracted. This period, when trains must creep out of the station before the gap fillers retract, introduces additional delay on southbound operations.

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Figure D.1-10. Union Square Gap Filler Functionality

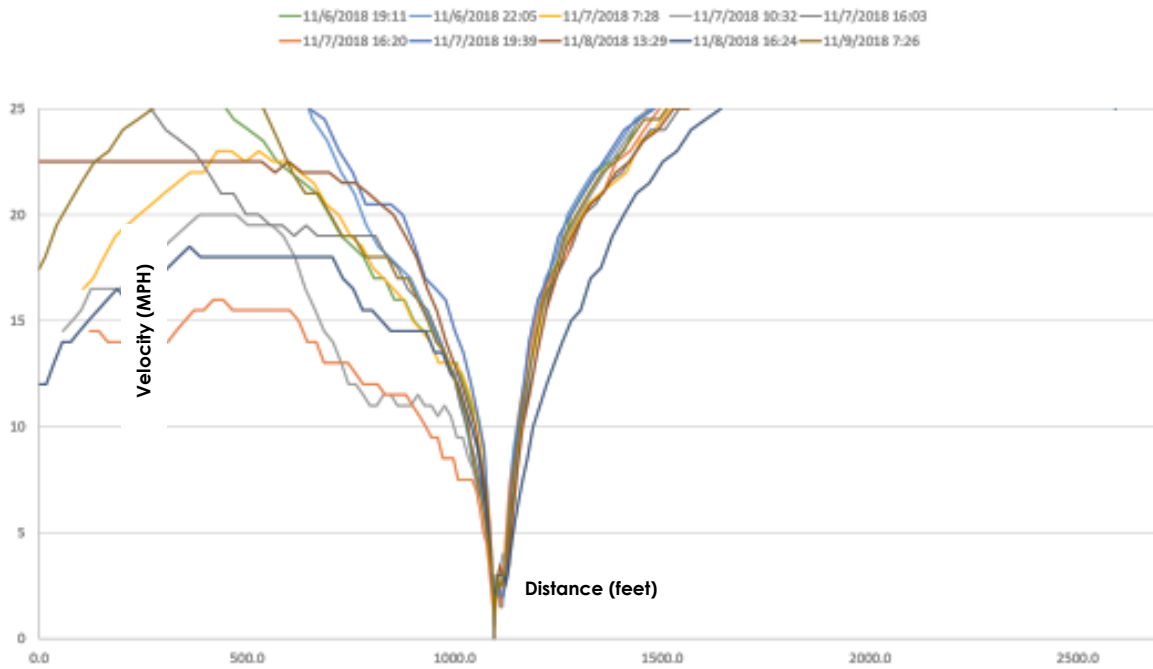
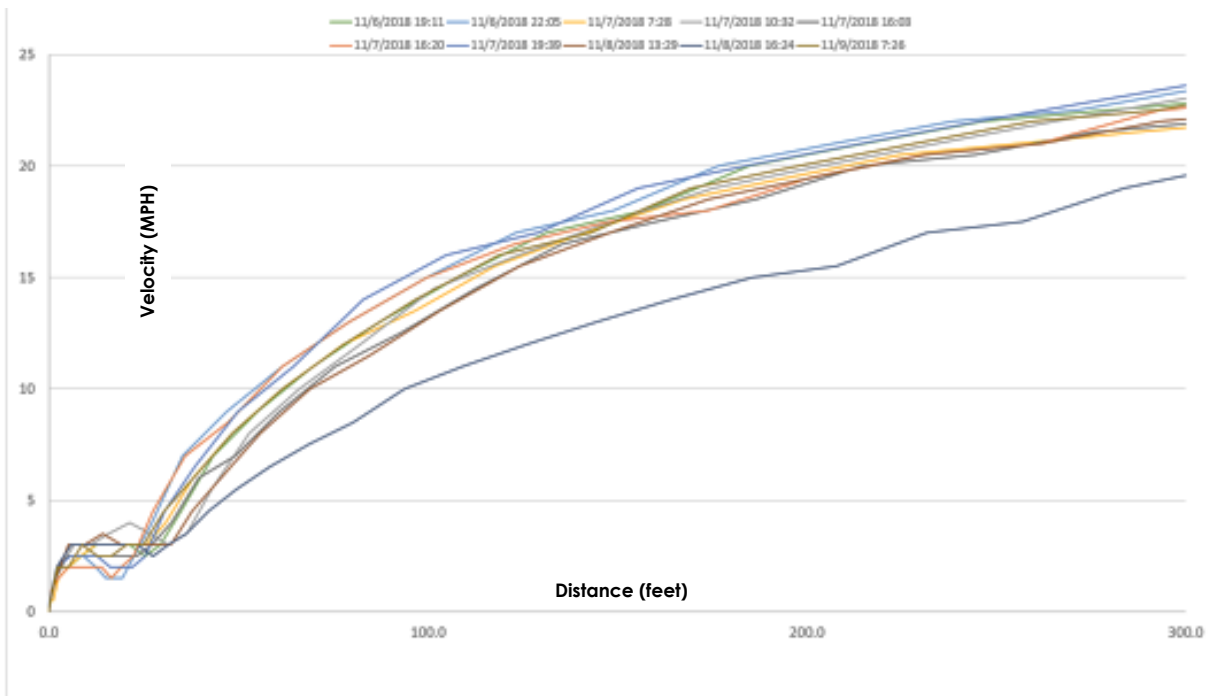


Figure D.1-11. Union Square Gap Filler Speed Restriction



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(c) Capacity Constraints - General

The STV Team's analysis shows that the northbound Lexington Avenue Line is more capacity-constrained overall than southbound under CBTC operations based on the "worst case" morning/evening peak dwell times. The longer peak northbound dwell of 55 seconds at Grand Central shown in Table D.1-10, versus the southbound dwell of 50 seconds shown in Table D.1-11, contribute to this delay.

The simulation analysis calculated the potential increase in TPH that could be realized if the first and second most capacity constraining locations were to be mitigated. In the northbound direction, this would require mitigations at Grand Central first and then at 125 Street. Removing the constraint at Grand Central would increase capacity from 27.6 TPH to 32.0 TPH. Removing the constraint at 125 Street would yield an additional small capacity increase to 32.4 TPH. Refer to Table D.1-10. In the southbound direction, mitigating the capacity constraint at Grand Central would result in a small increase in capacity from 31.2 TPH to 31.3 TPH. Removing the constraint at Union Square, however, could result in a significant capacity increase to 34.8 TPH. Refer to Table D.1-11. This is well above the theoretical level of service limit of 32 TPH that is expected ever to be scheduled on the line.

Table D.1-10. Eliminating Capacity Constraints - Northbound Max of Peaks Dwell Times (in seconds)

Northbound Dwells	Nevins Street	Borough Hall	Bowling Green	Wall Street	Fulton Street	Brooklyn Bridge	Union Square – 14 Street	Grand Central – 42 Street	59 Street	86 Street	125 Street	Trains per Hour
Original	30	35	35	30	35	30	45	55	35	35	45	27.6
Removed 1st Constraint (Grand Central)	30	35	35	30	35	30	45	Constraint Removed	35	35	45	32.0
Removed 2nd Constraint (125 Street)	30	35	35	30	35	30	45	Constraint Removed	35	35	Constraint Removed	32.4

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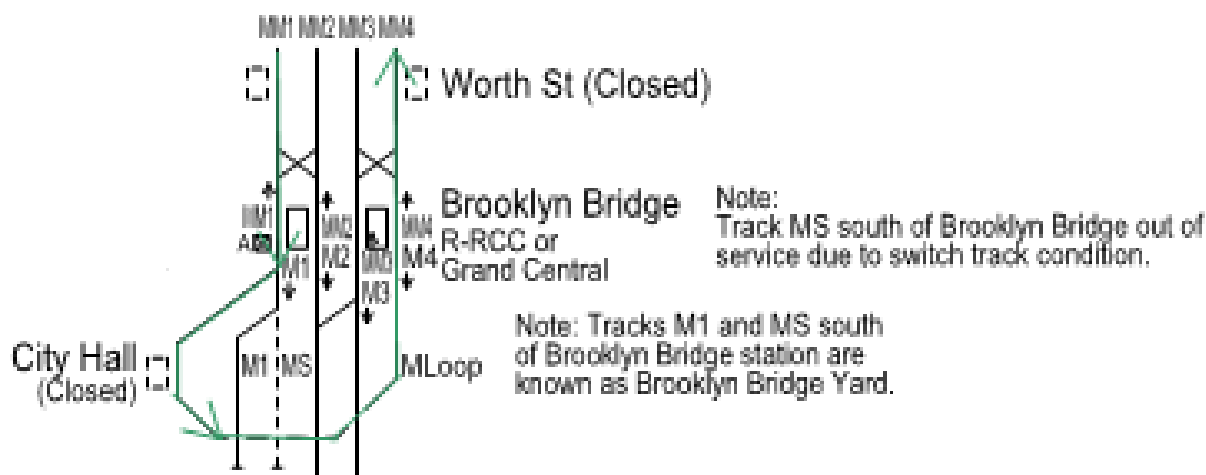
Table D.1-11. Eliminating Capacity Constraints - Southbound Max of Peaks Dwell Times (in seconds)

Southbound Dwells	125 Street	86 Street	59 Street	Grand Central – 42 Street	Union Square – 14 Street	Brooklyn Bridge	Fulton Street	Wall Street	Bowling Green	Borough Hall	Nevins Street	Trains per Hour
Original	40	35	40	50	50	30	35	35	35	35	30	31.3
Removed 1st Constraint (Grand Central)	40	35	40	Constraint Removed	50	30	35	35	35	35	30	31.3
Removed 2nd Constraint (Union Sq – 14 Street)	40	35	40	Constraint Removed	Constraint Removed	30	35	35	35	35	30	34.8

(d) *Constraints and Capacity Improvements at Brooklyn Bridge – City Hall*

Brooklyn Bridge – City Hall station is the southern terminus of the 6 Line. Upon terminating at this station on the southbound local track, 6 Line trains proceed around the City Hall Loop to start their northbound runs on the northbound local track. The turn onto the loop is a forced diverge; the straight run is to a storage track just beyond the platform. Refer to Figure D.1-12.

Figure D.1-12. 6 Line Terminus and Route (in green): Brooklyn Bridge – City Hall



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NYCT gave the STV Team the task to investigate whether the speed could be increased for a train departing the station for the loop. The STV Team proposed removing the storage tracks and straight railing the interlocking south of Brooklyn Bridge-City Hall. The STV Team noted that the interlocking south of the station is a constraint preventing 30 TPH operation for the 6 Line under CBTC. Straight railing the switch and removing the interlocking would eliminate the fixed block nature of the interlocking in a very slow speed area, eliminating the CBTC constraint. The STV Team noted that this proposed capital improvement may not be necessary if NYCT's future demand projections for the 6 Line do not justify 30 TPH operation.

NYCT MOW Engineering noted that there are plans to provide a track connection between the storage track and the southbound express track during the Lexington Avenue CBTC contract, something the tunnel configuration would allow. Eliminating the spare tracks would remove potential storage spare for work trains, leaving few alternatives for storage elsewhere along the Lexington Avenue line.

(i) Recommendations

The STV Team recommends that no track changes be made at this location.

(e) Constraints and Capacity Improvements at 14 Street - Union Square

Figure D.1-13. Gap Filler at 14 Street - Union Square, Southbound Platform



The STV Team was assigned the task of determining where 14 Street - Union Square station falls within the hierarchy of most capacity-constraining locations. If Union Square were found to be at or close to the most capacity-constraining location on the line, then that would argue for the southbound platforms to be relocated to the north to reduce curved station tracks and eliminate the gap fillers. If Union Square were found not to be at the top of the list, then it would argue that NYCT should

retain the current station with gap filler impacts, focusing investment dollars elsewhere. Existing conditions at Union Square southbound constrains future operations to 31.3 TPH, which is close to the theoretical limit of 32 TPH expected to operate on the line in the future. Grand Central and Union Square impose virtually the same system constraint southbound under future operations at the 31.2 - 31.3 TPH level.

Local tracks, which are much less capacity-constrained, were not included in this analysis.

NYCT requested that four improvement scenarios be evaluated at Union Square. **Scenario 1** assessed the benefit that could be realized should the southbound platform be relocated north of the curve to improve speeds and eliminate the need for gap fillers. Refer to Figure D.1-14. If Grand Central were removed as a constraint (through aggressive dwell time improvement or some other means), overall southbound Lexington Avenue Line capacity would increase by 2 TPH, from 31.3 TPH to 33.5 TPH. Removing the constraint at Union Square would increase capacity to 34.8 TPH. Refer to Table D.1-12.

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Figure D.1-14. Union Square Improvement Scenario 1: Relocate southbound platform to the north

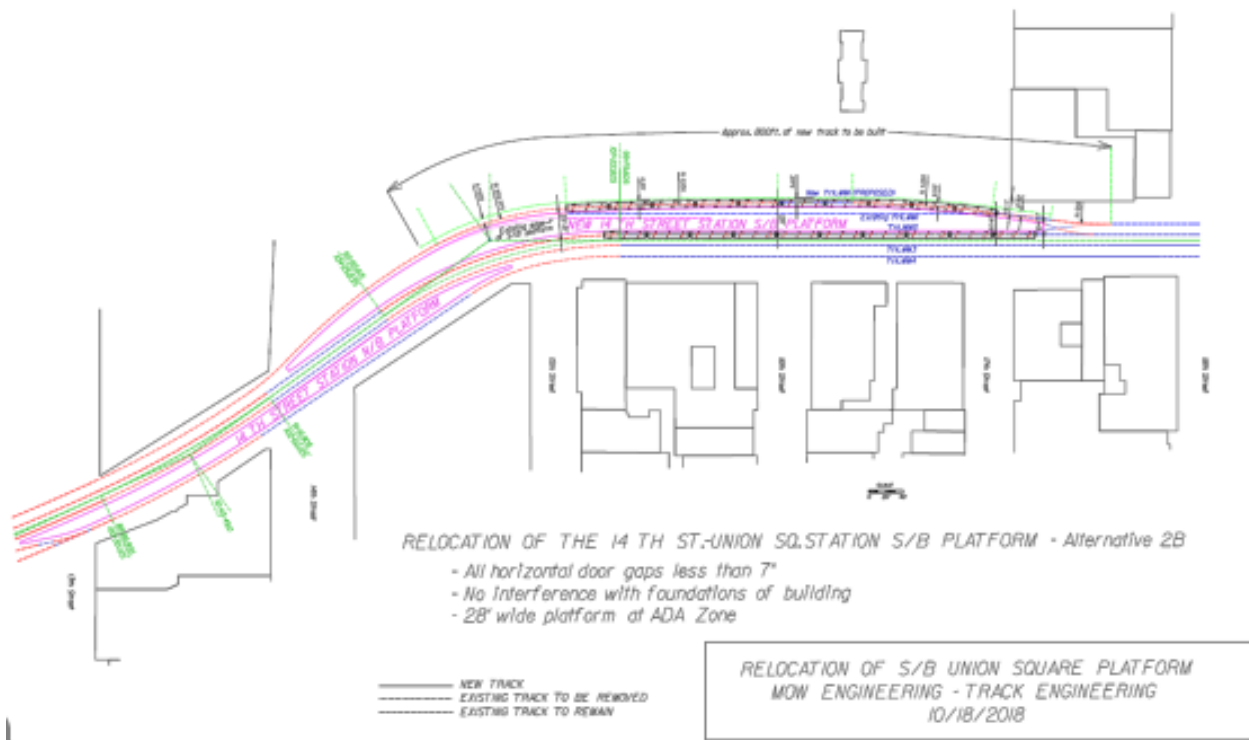


Table D.1-12. Union Square Improvement Scenario 1 – Max of Peaks Crush Capacity SB Dwell Times

Southbound Dwells	125 Street	86 Street	59 Street	Grand Central – 42 Street	Union Square – 14 Street	Brooklyn Bridge	Fulton Street	Wall Street	Bowling Green	Borough Hall	Nevens Street	Trains per Hour
Scenario 1	40	35	40	50	42	30	35	35	35	35	30	31.6
Removed 1st Constraint (Grand Central)	40	35	40	Constraint Removed	42	30	35	35	35	35	30	33.5
Removed 2nd Constraint (Union Sq – 14 Street)	40	35	40	Constraint Removed	Constraint Removed	30	35	35	35	35	30	34.8

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Scenario 2 evaluated removing the interlocking north of the station to allow for true “moving block” CBTC logic in the area. If Grand Central were removed as a constraint, the existing Union Square station were retained, and the interlocking north of the station were removed, there would be no increase to southbound Lexington Avenue Line capacity. If Grand Central were removed as a constraint, the existing Union Square station were retained, and the response time of the gap fillers were improved, overall southbound Lexington Avenue Line capacity would increase by 1 TPH (from 31.3 TPH to 32.6 TPH). Refer to Table D.1-13.

Scenario 3 evaluated the benefit of improved deployment/retraction times of the gap fillers. The analysis assumed that deployment time would be improved by 2.5 seconds (modeled as reduced dwell) and that retraction time is improved by 2.5 seconds (modeled as a departure speed of 2.5 MPH for 26 feet, rather than the future baseline 35 feet). Again, if Grand Central were removed as a constraint through aggressive dwell time improvement or some other means, the increase in overall Lexington Avenue Line capacity to 32.6 TPH would be less than observed for Scenario 1 but greater than Scenario 2. Removing the constraint at Union Square would provide the highest theoretical capacity of all the modeled scenarios, yielding an increase to 34.9 TPH. Refer to Table D.1-14.

Scenario 4 evaluated a combination of Scenarios 2 and 3 and was shown to have the same benefits as Scenario 3, suggesting that it is not necessary to remove the interlocking north of the station if gap filler response times are improved. Refer to Table D.1-14.

Table D.1-13. Union Square Improvement Scenario 2 – Max of Peaks Crush Capacity SB Dwell Times

Southbound Dwells	125 Street	86 Street	59 Street	Grand Central – 42 Street	Union Square – 14 Street	Brooklyn Bridge	Fulton Street	Wall Street	Bowling Green	Borough Hall	Nevins Street	Trains per Hour
Scenario 2	40	35	40	50	50	30	35	35	35	35	30	31.3
Removed 1st Constraint (Grand Central)	40	35	40	Constraint Removed	50	30	35	35	35	35	30	31.3
Removed 2nd Constraint (Union Sq – 14 Street)	40	35	40	Constraint Removed	Constraint Removed	30	35	35	35	35	30	34.8

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Table D.1-14. Union Square Improvement Scenarios 3 and 4 – Max of Peaks Crush Capacity SB Dwell Times

Southbound Dwells	125 Street	86 Street	59 Street	Grand Central – 42 Street	Union Square – 14 Street	Brooklyn Bridge	Fulton Street	Wall Street	Bowling Green	Borough Hall	Nevins Street	Trains per Hour
Scenarios 3 & 4	40	35	40	50	48	30	35	35	35	35	30	31.5
Removed 1st Constraint (Grand Central)	40	35	40	Constraint Removed	48	30	35	35	35	35	30	32.6
Removed 2nd Constraint (Union Sq – 14 Street)	40	35	40	Constraint Removed	Constraint Removed	30	35	35	35	35	30	34.9

(i) Recommendations

The STV Team recommends NYCT pursue the improvements in Scenario 3. Replacing the existing gap fillers and, if required, gap filler signals would improve overall reliability and would enable greater throughput.

(f) Constraints and Capacity Improvements at Grand Central

In tandem with the study of capacity improvements at Union Square, the STV Team examined possible capacity improvements at Grand Central. The starting point for this part of the study was the baseline CBTC capacity (that is, without removing capacity constraints at Union Square and Grand Central) of 27.6 TPH northbound from Grand Central (refer to Table D.1-10) and 31.2 TPH southbound from Grand Central. This capacity is constrained by dwell times at Grand Central; see the “Original” times in Table D.1-10 and Table D.1-11.

The key question here was how much lower the 55-second peak northbound dwell would need to be for northbound capacity to match southbound capacity. Northbound operations are more constraining because of the relationship of station platform limits, dwell times, approach speed, leaving speed and long interlocking north of the station. Through iterative studies, a 40-second northbound dwell was found to achieve about the same capacity as southbound, 31.3 TPH.

NYCT requested that the STV Team investigate improvements north and south of Grand Central, resulting in the following proposed conceptual track improvements:

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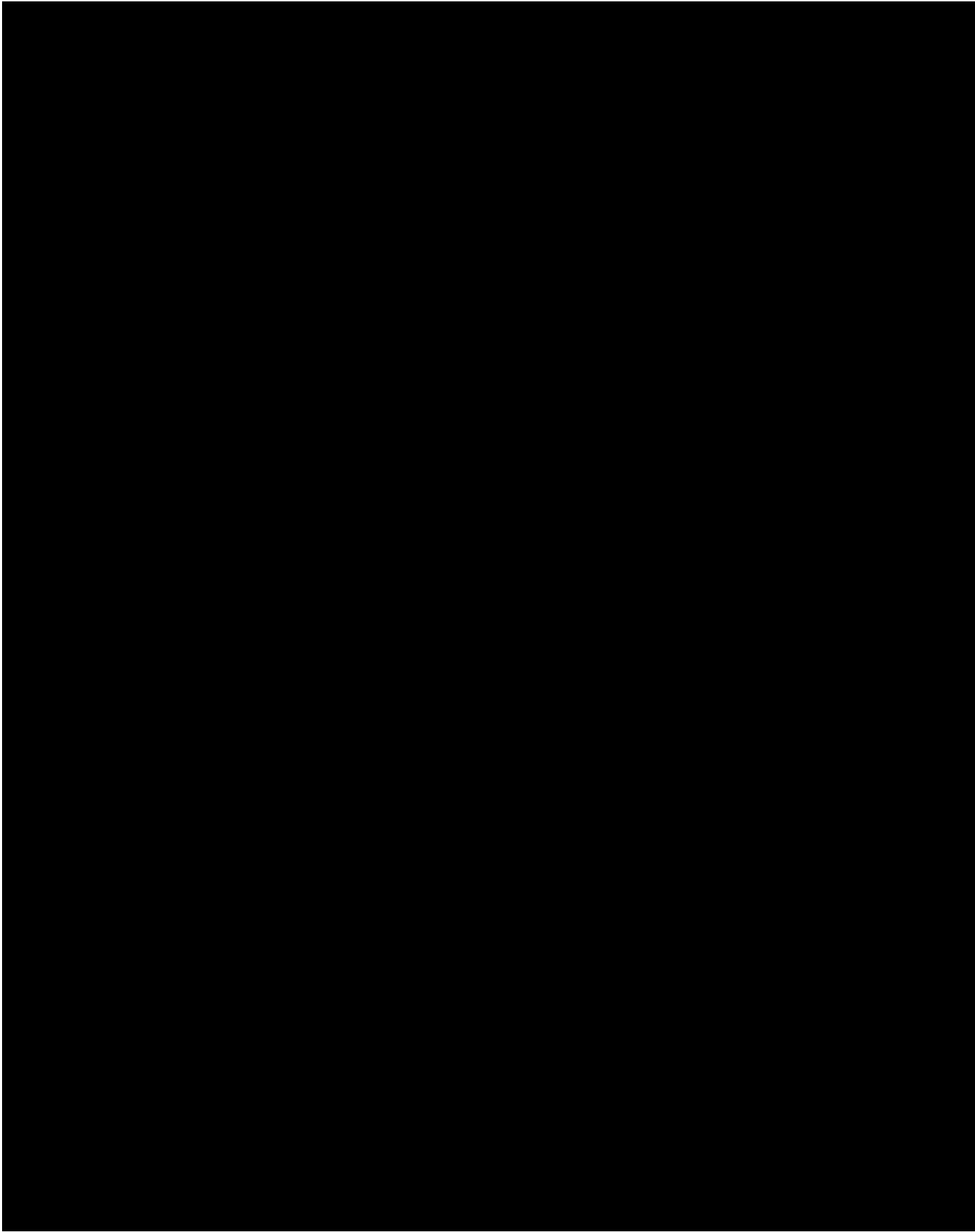
- North of Platform to Upper Level/Lower Level Split:
 - Northbound Local turnout to Northbound Express
 - Northbound Express turnout to Northbound Local
 - Northbound Express turnout to Southbound Express
 - Southbound Express turnout to Southbound Local
 - Southbound Local turnout to Southbound Express
- South of Platform
 - Southbound Local flyover of Shuttle lead track
 - Southbound Express curve realignment into footprint of abandoned original (pre-1918) southbound express track way

(i) *North of Platform – Grand Central*

NYCT has had the STV Team examine the interlocking immediately north of Grand Central station to improve speed and throughput through the interlocking and south of the station. The distance between the north end of the platform and the beginning of grade separation between local and express tracks is approximately 600 feet. Within this space, the objective was to provide all existing connections under conditions allowing for higher speeds. This short distance creates a challenging spatial limitation for any changes. A train cannot enter the station from the south until a train in the station has cleared the block where the interlocking begins. Changes to this interlocking would improve throughput under the existing conventional signaling and, more importantly, under CBTC.

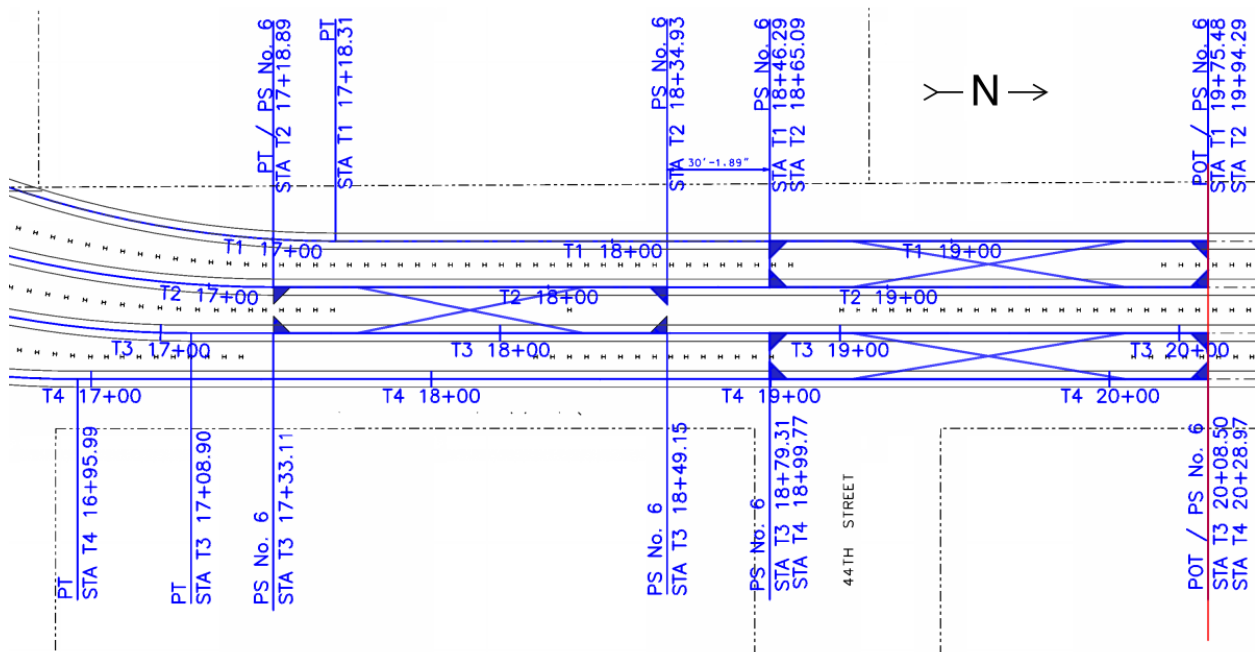
The STV Team began this part of the study with the constraint of preserving an equivalent of the existing ladder track from Track 4 north to Track 1, in other words maintaining the ability to move a train from Track 4 to Track 1, or vice versa, without necessarily preserving the existing ladder. The first part of this exercise was to design a new crossover from Track 4, immediately north of the end of platform, to Track 3, as shown in Figure D.1-15.

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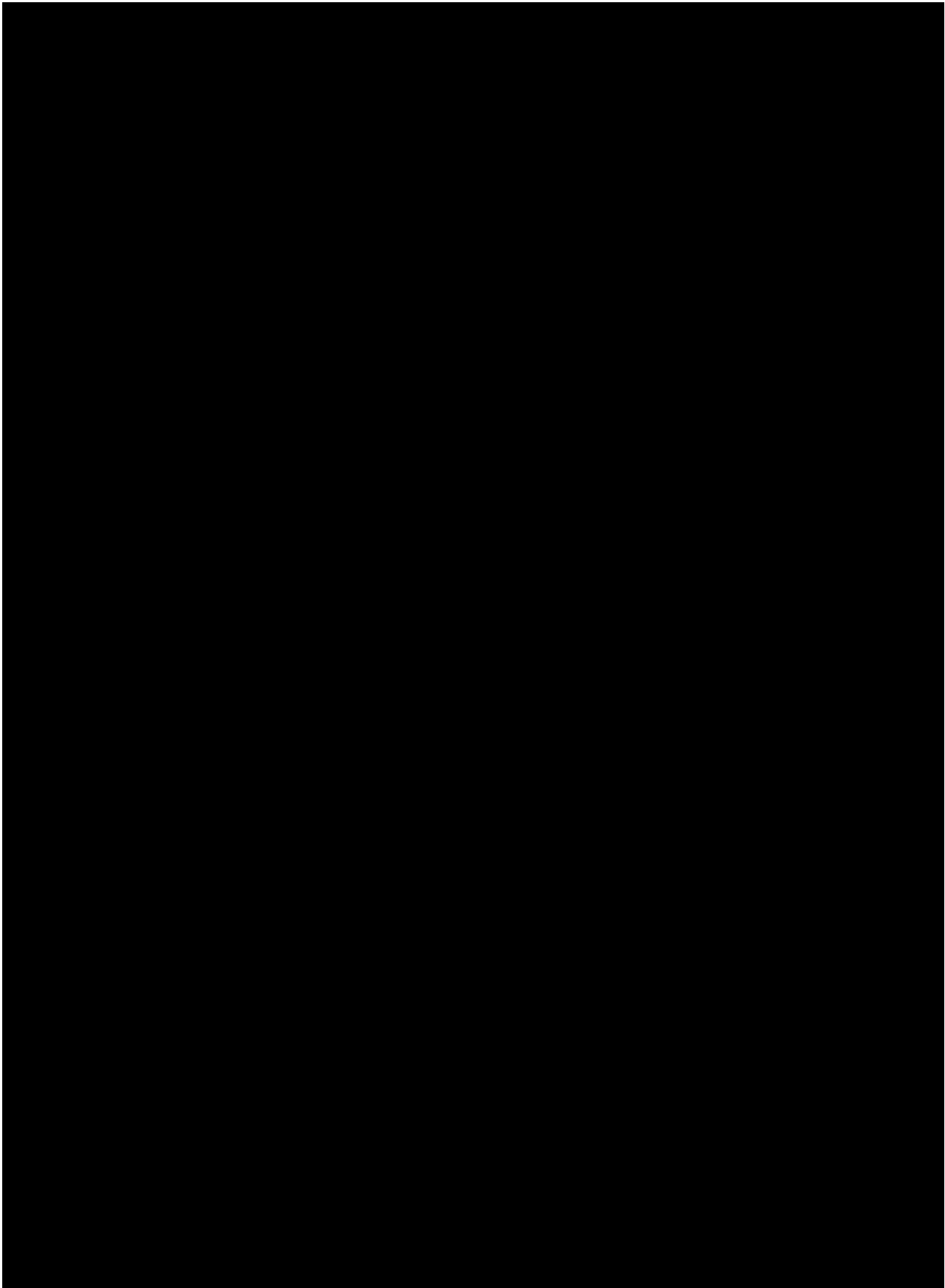
Figure D.1-17. Concept for Revised Interlocking



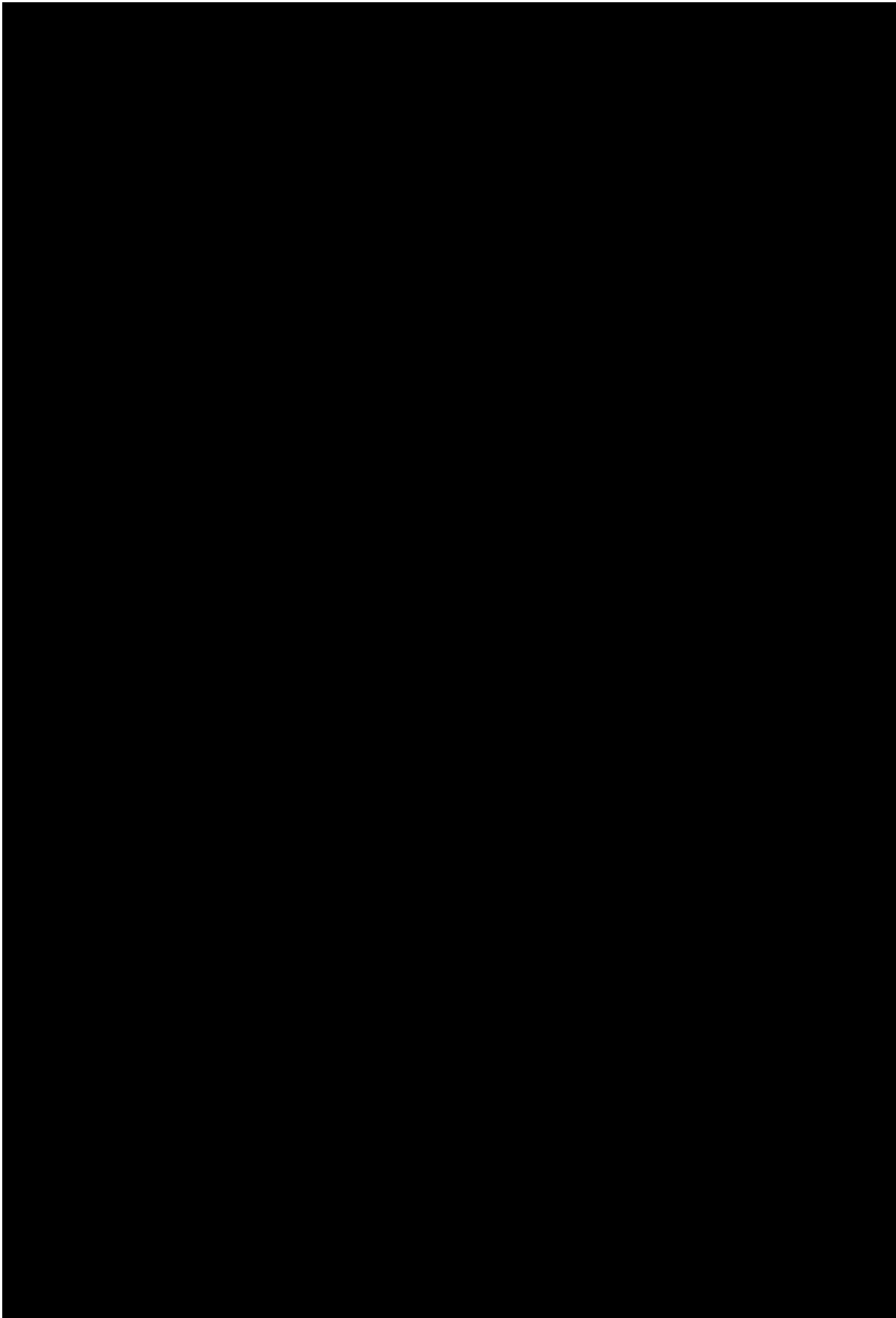
The proposed crossover would divide the existing interlocking into two more compact interlockings, moderating CBTC capacity constraints identified at this location; refer to Table D.1-10 and Table D.1-11. The STV Team explained that since CBTC treats the entire interlocking as one fixed block, the existing interlocking north of the station constrains service to 26 TPH northbound and 30 TPH southbound (based on practical capacity being defined as 90 percent of theoretical CBTC capacity).

At NYCT's suggestion the STV Team evaluated a variation on the above scheme that would result in the removal of fewer columns, would introduce two double-slip switches, and would preclude dividing the interlocking as the STV Team proposed. This is illustrated in Figure D.1-20. This proposal, however, would not fulfill the goal of subdividing the interlocking to provide a CBTC benefit of an additional 2 TPH of capacity gain at the most capacity-constraining location on the line. This proposal provides a cost/benefit reference point to the proposed interlocking subdivision. While it would reduce the cost and complexity of construction, it would provide little benefit to the operation of trains along the Lexington Avenue Line.

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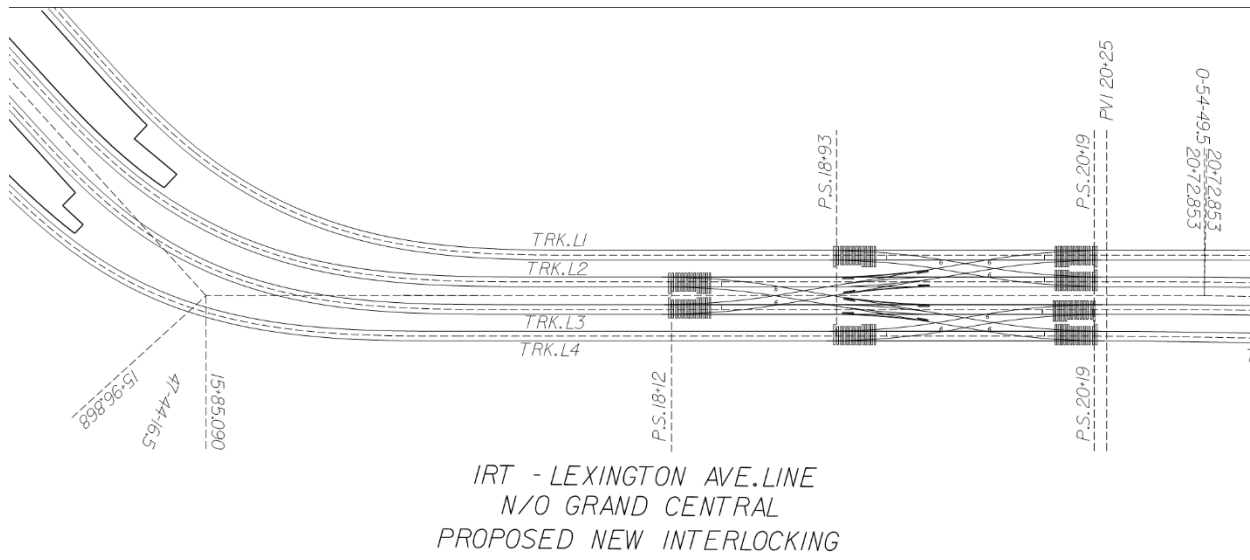


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Figure D.1-20. NYCT Concept, New Grand Central North Interlocking



(ii) South of Platform – Grand Central

The STV Team studied possible modifications of the track layout south of Grand Central station to the junction with the original twin tunnels between 38 Street and 40 Street. The original alignment of the IRT subway north of 33 Street station was in two two-track tunnels flanking the former streetcar tunnel, now vehicular tunnel, between 33 Street and 40 Street. The original subway curved west toward 42 Street and the original Grand Central express station, now the Grand Central shuttle station. To create a link to the new Lexington Avenue subway, the IRT's engineers designed the current "diagonal" express station that opened in 1918. Track links had to be created while preserving existing service. This explains the current divergence of Tracks 2 and 3 from the existing trackways and the connection of current Tracks 1 and 4. Refer to Figure D.1-21.

The STV Team considered briefly the approach of trains from the south into Grand Central and concluded that as both express and local trains would decelerate anyway while approaching the station, changes to the current alignment would not survive a cost-benefit analysis. For southbound trains from the station, the STV Team considered a more compact alignment of Track 2 (express), flattening the curvature of Track 2 (southbound express) into the original IRT southbound express track way from approximately a 200-foot radius to 250 feet, and increasing the track grade from 1.15 percent to 1.32 percent. Refer to Figure D.1-22. NYCT MOW Engineering deemed that the increased radius of curve would not justify the extensive service impacts during construction or the marginal speed improvement.

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Figure D.1-21. Connection of Current Subway and Original Subway at Grand Central

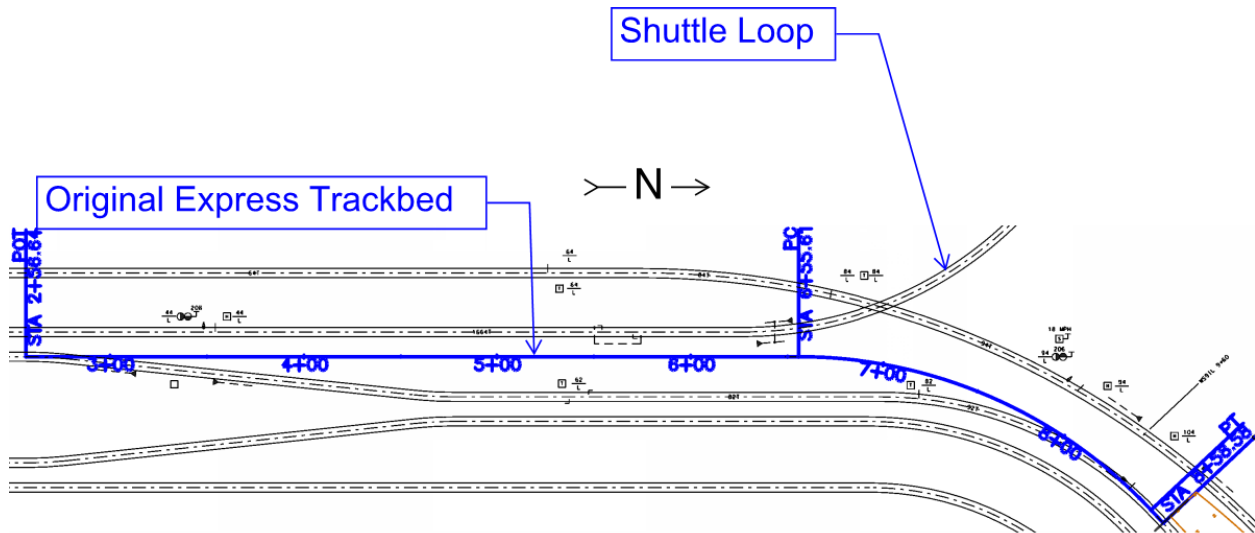
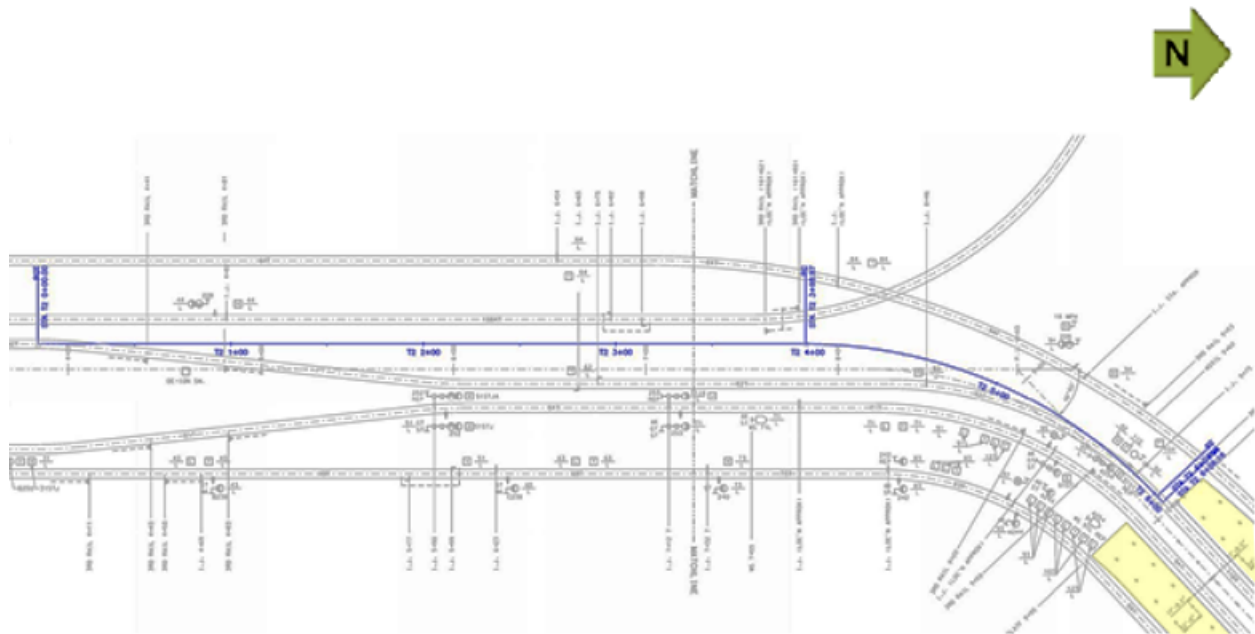


Figure D.1-22. Conceptual Reroute, Southbound Express, South of Grand Central



(i) Recommendations

The STV Team recommends NYCT make the changes to the interlocking north of Grand Central shown in Figure D.1-17 and Figure D.1-18 in order to address the capacity constraint there as far as possible with work that could be accomplished on nights and weekends. For a preliminary budgetary construction cost estimate refer to paragraph H.1.1.1.

The STV Team recommends no changes be made south of Grand Central.

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(g) Constraints and Capacity Improvements at 125 Street

125 Street is a two-level, four-track station configured to allow cross-platform transfers between express and local trains in the same direction on each level. South of the station there is a complex track layout that changes from upper level local/lower level express at 116 Street to upper level northbound (express and local)/lower level southbound (express and local) at 125 Street. North of the station the track layout changes again, with northbound and southbound express tracks leading to the two westerly tubes in the Harlem River tunnel and to the Jerome Avenue line, and northbound and southbound local tracks leading to the two easterly tubes in the Harlem River tunnel and to the Pelham line. Spur tracks and crossovers north and south of the station allow diversions between local and express tracks in both directions. Routes and connections are shown in Figure D.1-23, Figure D.1-24, Figure D.1-25, and Figure D.1-26. There are no at-grade conflicts in this area for regular revenue service.

Figure D.1-23. Northbound Local route (in green) through 125 Street

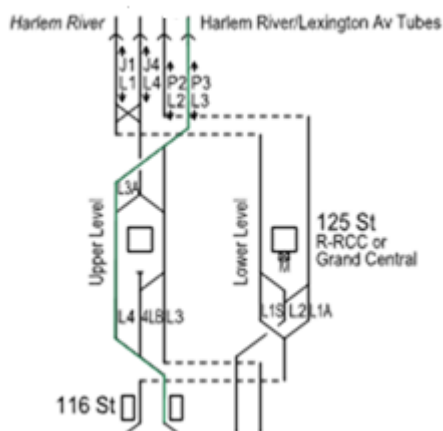


Figure D.1-24. Northbound Express route (in green) through 125 Street

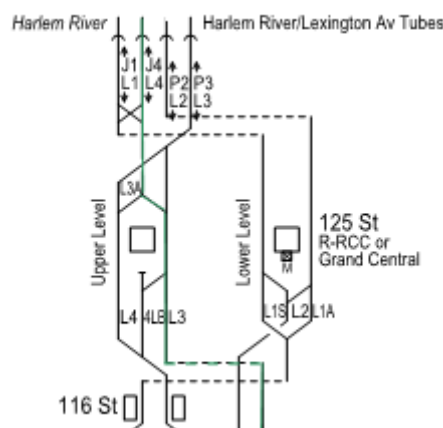


Figure D.1-25. Southbound Local route (in green) through 125 Street

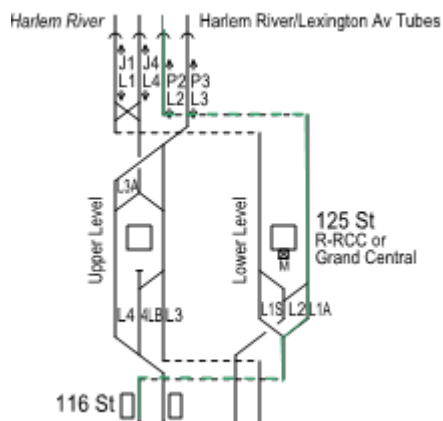
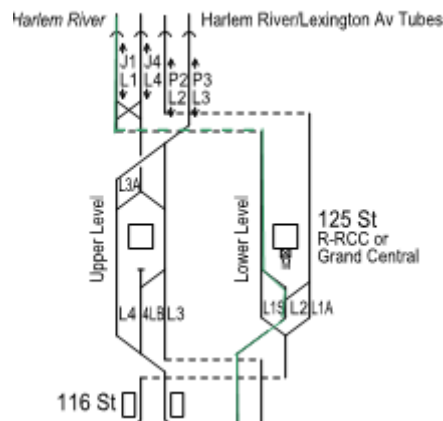


Figure D.1-26. Southbound Express route (in green) through 125 Street



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Factors influencing capacity exist north of the station, not south. Slow speeds prevail on both express (Jerome) and local (Pelham) routes going from the station to the north, and to the north from the station; these were verified by field observation. The STV Team noted that a 10 MPH speed limit applied to switch #441 north of 125 Street is overly conservative and will be updated. Slow speeds approaching 125 Street from the north influence, and are influenced by, sorting southbound 6 Local and 6 Express trains at the first station north on the Pelham line (3 Avenue – 138 Street) where three tracks narrow to two; sorting 4 Line and 5 Line southbound rush hour trains at the first station north on the Jerome Avenue line (138 Street – Grand Concourse) where three tracks narrow to two; and sorting 4 Line and 5 Line trains at the junction between the Jerome Avenue line and the White Plains Road line south of 149 Street – Grand Concourse station.

(i) *Recommendations*

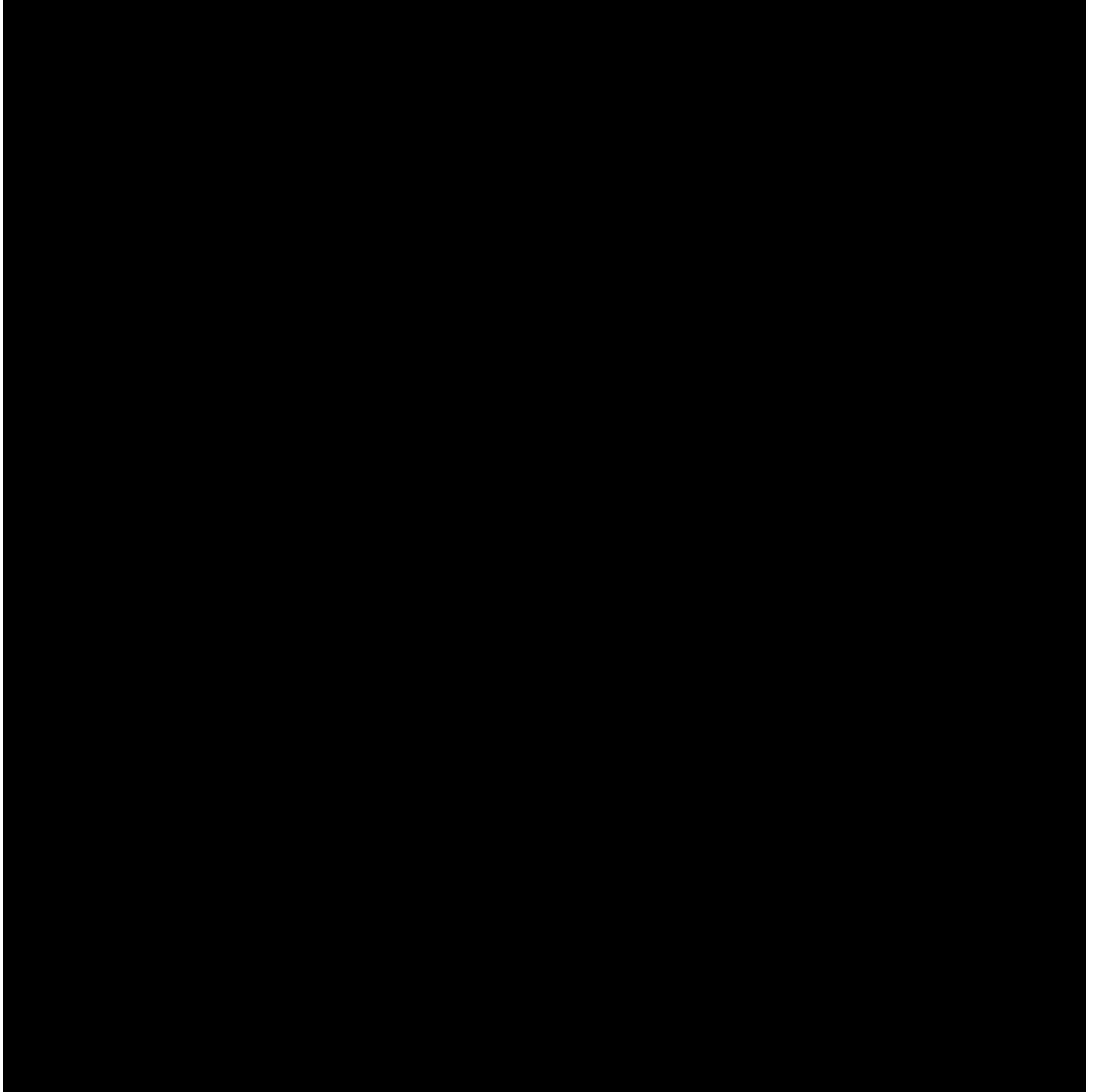
The STV Team recommends NYCT review speed limits north of the station in both directions and increase them where it is safe to do so.

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D.1.3 Phase III - Seventh Avenue Line CBTC Analysis

D.1.3.1 Territory Covered

The territory subject of Phase III of this study is the “A” Division Seventh Avenue Line, north from Nevins Street (2 Line, 3 Line) and South Ferry (1 Line) to 145 Street station (1 Line), 3 Avenue – 149 Street station (2 Line), and Harlem – 148 Street – Lenox Terminal station (3 Line). Refer to Figure D.1-27.



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D.1.3.2 Performance Modeling

The STV Team performed simulations of the 2 Line/3 Line versus event recorder data from R142 cars provided by NYCT, in the Phase III territory. For the results of these simulations refer to Section F.2, Train Event Recorder Data and Corresponding TrainOps® Velocity versus Distance Plots. These plots show event recorder data versus both uncalibrated and calibrated TrainOps® simulations. In most cases the calibrated simulated speeds between stations were less than the uncalibrated speeds. These data should be analyzed from one pair of stations to the next to determine how running times might be reduced without waiting for the implementation of CBTC in the Phase III territory.

In the course of the study NYCT asked the STV Team how the simulation model makes allowances for varying Train Operator (T/O) adherence to Station Time (ST) and Grade Time (GT) timers, noting that operators are often unable to adhere to the posted speeds.

The STV Team noted that ST timer and control line logic is site-specific and accurately reflected in the model. Trains are profiled towards ST signals at stop and will start accelerating after a brief T/O reaction time if an ST signal upgrades from red to yellow.

The STV Team noted that GT timer logic is not specifically included in the model, but the speed effects of GT are. NYCT Division of Car Equipment (DCE) Event Recorder data were used to reduce speeds to accurately reflect T/O behavior.

D.1.3.3 Focus Area: Lenox Avenue Line

(a) Background

The Lenox Avenue line opened in 1904 with the main line north of 135 Street station continuing beneath the Harlem River into The Bronx, the route used by 2 Line trains today. A spur, used today by 3 Line trains, continued from 142 Street Interlocking to a storage yard (Lenox Yard) and the main shops of the IRT subway that have been demolished. 145 Street station was built on this spur. As was case with most original IRT stations, the platforms were only long enough to accommodate five-car trains. Unlike most IRT stations, the platforms at 145 Street were not lengthened after World War II to accommodate ten-car trains. In 1968 a new station, Harlem - 148 Street – Lenox Terminal, opened in Lenox Yard as the terminal for 3 Line trains and the 145 Street station was kept open, unimproved.

Land use in the vicinity of 145 Street station is shown in Figure D.1-28.

The STV Team was assigned several interrelated tasks here:

- Measure the maximum capacity of the terminal at Harlem - 148 Street;
- Evaluate train moves between the Harlem – 148 Street – Lenox Terminal station and Lenox Yard;
- Evaluate the “flat,” i.e. not grade-separated, junction at 142 Street for how conflicts between northbound 3 Line trains and southbound 2 Line trains at this junction might be mitigated or avoided; and

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- Evaluate the potential for increasing capacity on the **3** Line.

Figure D.1-28. Land Use, Vicinity of 145 Street Station



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(b) Methodology

Two scenarios were modeled for Harlem - 148 Street: Revenue services only, and a 50/50 mix of revenue services and non-revenue trips from Lenox Yard, which reverse near 145 Street and enter service at Harlem - 148 Street.

The junction at 142 Street represents a significant additional constraint on the capacity of this line. Only services between Central Park North (110 Street) and Harlem - 148 Street, i.e. 3 Line trains, were modeled. The results of this modeling appear in Table D.1-15.

Table D.1-15. Modeling of Service on Lenox Avenue line

Scenario	Average Simulated Headway (MM:SS)	Trains per hour
Trip stop (revenue turns only)	3:27	18
Trip stop (additional yard trains)	4:21	13
CBTC (revenue turns only)	2:29	24
CBTC (additional yard trains)	3:42	16

The headway/capacity figures reported are for the total number of southbound services, which includes those from both northbound services and trips that entered revenue service at Harlem - 148 Street. Turning trains on the running lines near 145 Street consumes significant capacity. This constraint is more severe under CBTC.

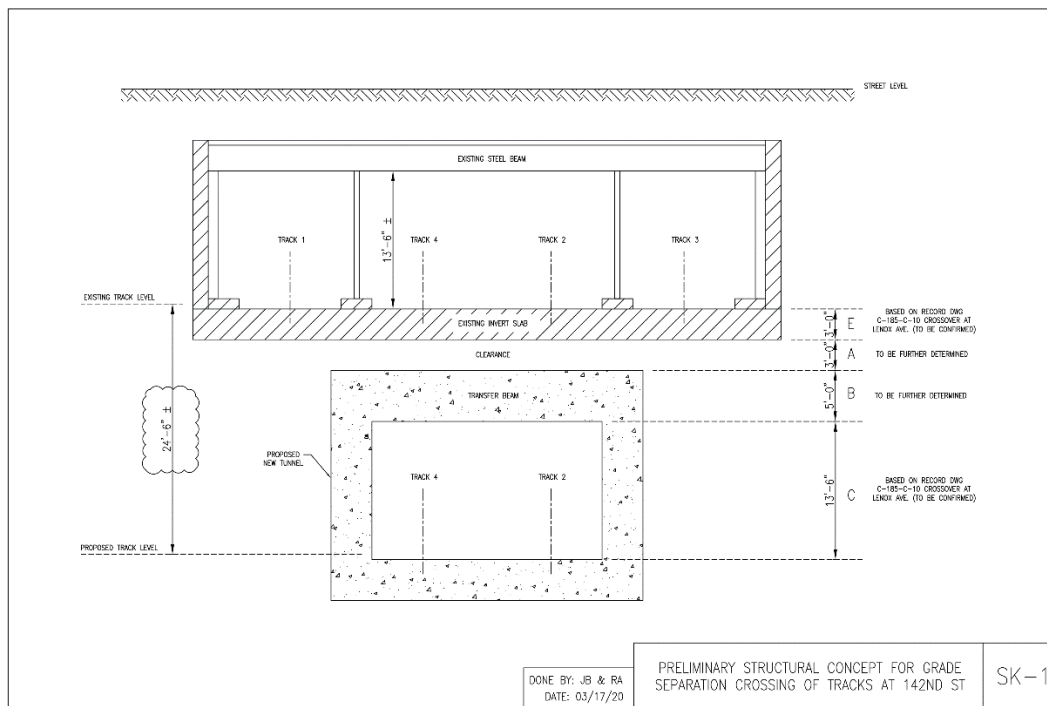
(c) Findings

The STV Team investigated reconfiguring the northbound track used by 3 Line trains to “duck under” the track used by southbound 2 Line trains (connecting to the Harlem River tunnel). NYCT MOW Engineering noted that the tunnel construction in this region changes from cut-and-cover under Lenox Avenue to arch-and-bore for the Harlem River Tunnel, which may become a barrier to significant structural re-work. Even in the absence of this barrier, the grade of the northbound track from the “duck under” to 145 Street station would be unacceptably steep. This is deemed a fatal flaw. Figure D.1-29 shows that the base of the track way for a “duck under” would be at least 24 feet 6 inches below the base of the existing track way.

The STV Team proposed a No. 8 double-slip switch that would allow northbound 2 Line trains to access the Harlem River tunnel. NYCT Engineering responded that installing a double-slip switch would limit trains traveling over the MOW straight route to 10 MPH. This is deemed a fatal flaw.

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Figure D.1-29. Preliminary Structural Concept, Grade Separation, 142 Street



NYCT concluded that given existing space and track constraints, this location may not be suitable for the STV Team's proposed conceptual improvements. STV noted that if no capital improvements are made in the area, the Phases I - IV CBTC model can nonetheless support 15 TPH each on the **2** and **3** Lines.

The STV Team reviewed its proposed southward platform extensions at 145 Street to facilitate yard put-ins and lay-ups from the station without operating to 148 Street. Under this proposal, at a minimum the northbound platform would be lengthened to accommodate ten-car trains, thus allowing a train to be cleared easily before proceeding to the yard. This layout was found to be acceptable at a conceptual level and the STV Team proceeded with CBTC network simulation where yard put-ins and lay-ups do not operate to 148 Street unless needed to maintain a 6 TPH service level during the morning and evening peaks as well as at midday.

This improvement would have a beneficial effect on performance of the **3** Line and all six lines included in this study over the Future CBTC Baseline. Refer to Table D.1-16 and Table D.1-17.

In summary, with the improvements at 145 Street, **3** Line on-time performance (OTP) increases from 90.8% to 95.0%. Systemwide OTP increases from 94.8% to 95.5%; however, **2** Line OTP decreases to 92.6% (down from 93.7% Future CBTC Baseline). **3** Line average travel times decrease in both directions during both peak periods.

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Table D.1-16. 145 Street – Lenox Avenue Station: Comparison of Terminal On-Time Performance

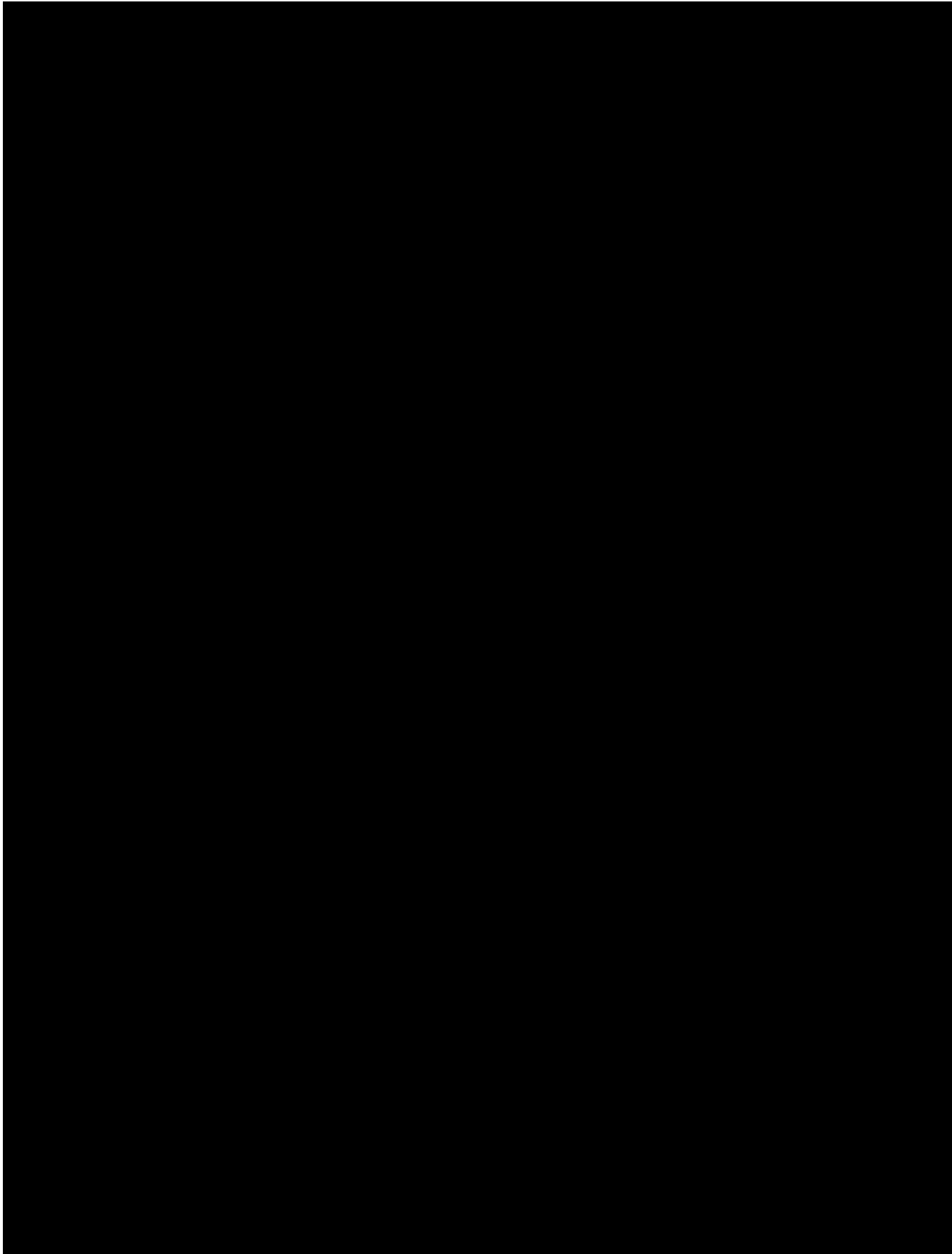
Subway Line	Future Baseline CBTC (Yard trips operate to 148 Street)	145 Street Improvements (Yard trips operate to 145 Street)
1	93.0%	93.0%
2	93.7%	92.6%
3	90.8%	95.0%
4	98.4%	99.3%
5	94.3%	96.0%
6	97.2%	97.2%
Average	94.8%	95.5%

Table D.1-17. 145 Street – Lenox Avenue Station Average Travel Time Comparison

Future Baseline CBTC									
	Northbound			Southbound			Overall		
	Min	Max	Average	Min	Max	Average	Min	Max	Average
AM	0:57:10	1:03:15	0:59:41	0:57:02	1:02:11	0:59:11	0:57:02	1:03:15	0:59:25
PM	1:00:01	1:04:46	1:01:31	0:57:47	1:05:29	1:00:54	0:57:46	1:05:29	1:01:13
Both	0:57:10	1:04:46	1:00:39	0:57:02	1:05:29	1:00:01	0:57:02	1:05:29	1:00:19

145 Street Improvements									
	Northbound			Southbound			Overall		
	Min	Max	Average	Min	Max	Average	Min	Max	Average
AM	0:57:44	1:00:08	0:58:59	0:57:03	1:00:59	0:58:14	0:57:03	1:00:59	0:58:40
PM	0:59:02	1:03:38	1:00:45	0:57:46	1:05:29	0:59:58	0:57:46	1:05:29	1:00:21
Both	0:57:44	1:03:38	0:59:51	0:57:03	1:05:29	0:59:15	0:57:03	1:05:29	0:59:34

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(d) *Recommendations*

(i) *145 Street Station and Terminal Operations*

The STV Team proposes that at least the northbound platform, and ideally both platforms, at 145 Street be extended to the south to allow the whole of a ten-car train to board or discharge passengers. Refer to Figure D.1-30. The improvement of this station should include full accessibility. This work would be in the interest of convenience, safety, and allowing put-ins to Lenox Yard to terminate at 145 Street, rather than continue to Harlem – 148 Street and make a series of complex, time-consuming, and capacity-constraining moves to Lenox Yard. No additional track work would be needed; the alignment south of the station is tangent and there is room to extend both platforms. Some signal modifications and sidewalk restrictions would be required during construction. For a preliminary budgetary construction cost estimate refer to Section H.1.2.

(i) *142 Street Junction*

The STV Team recommends no changes to the junction at 142 Street, instead addressing conflicts between southbound 2 Line trains and northbound 3 Line trains through operational improvements.

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D.1.4 Phase IV - Capacity Constraints, A-Division in The Bronx

D.1.4.1 Territory Covered

The territory subject of Phase IV of this study is the Bronx A-Division terminals, focusing on 240 Street Yard/Van Cortlandt Park -242 Street station (1 Line), East 180 Street station and yard (2 Line, 5 Line), Nereid Avenue station/Wakefield – 241 Street station/239 Street Yard (2 Line, 5 Line), Parkchester station and Pelham Bay Park station (6 Line). Refer to Figure D.1-31.

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D.1.4.2 Performance Modeling

The STV Team performed simulations of the 4 Line in both directions between 138 Street – Grand Concourse and Woodlawn, and the 5 Line southbound between Eastchester – Dyre Avenue and 125 Street, versus event recorder data provided by NYCT from R142 cars. The results of these simulations appear in Section F.2. In most cases the calibrated simulated speeds between stations were less than the uncalibrated speeds. These data should be analyzed from one pair of stations to the next to determine how running times might be reduced without waiting for the implementation of CBTC in the Phase IV territory.

In the course of the study NYCT asked the STV Team how the simulation model makes allowances for varying Train Operator (T/O) adherence to Station Time (ST) and Grade Time (GT) timers, noting that operators are often unable to adhere to the posted speeds.

The STV Team noted that ST timer and control line logic is site-specific and accurately reflected in the model. Trains are profiled towards ST signals at stop and will start accelerating after a brief T/O reaction time if an ST signal upgrades from red to yellow.

The STV Team noted that GT timer logic is not specifically included in the model, but the speed effects of GT are. NYCT Division of Car Equipment (DCE) Event Recorder data were used to reduce speeds to accurately reflect T/O behavior.

D.1.4.3 Focus Area: 240 Street Yard / Van Cortlandt Park - 242 Street

(a) Background

240 Street Yard is the storage yard and maintenance base for 1 Line trains. North of the penultimate station on the line, 238 Street, a two-track yard lead diverges north and west from Track BB1 on the main line at a flat junction. There is a storage track west of Track BB1 that stub-ends just north of 238 Street station, feeding into the yard lead. Northbound trains can and sometimes do terminate at 238 Street before going to the yard. Otherwise, trains terminating at the last station, Van Cortlandt Park – 242 Street, must make a reverse move on Track BB1 or Track BBM past the interlocking north of 238 Street station before moving to the yard. Refer to the corresponding highlighted area in Figure D.1-31.

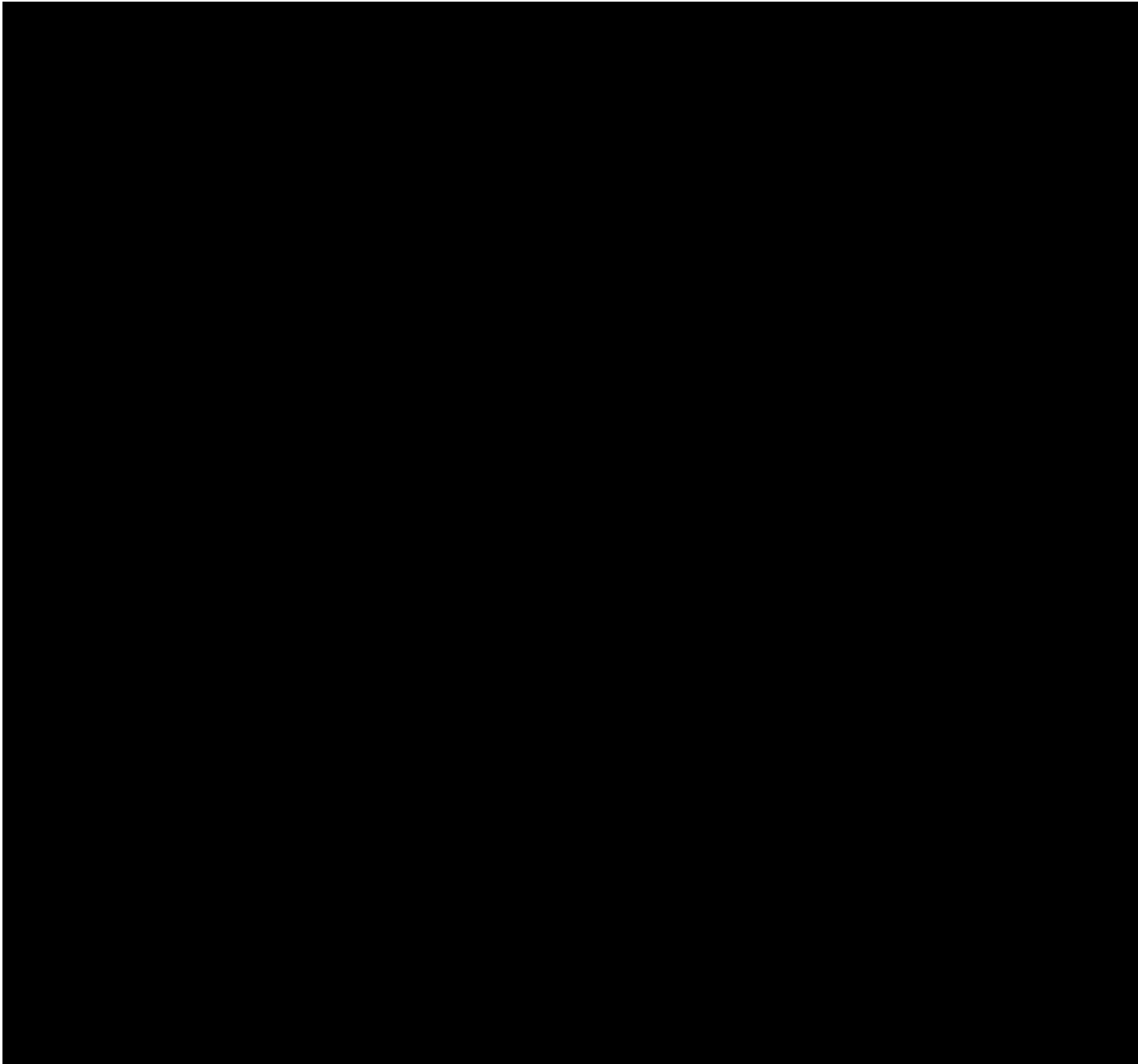
(b) Objective

Measure maximum capacity of Van Cortlandt Park - 242 Street terminal with and without a new yard lead track direct to 240 Street Yard.

(c) Methodology

Batches of 50 trains (at a set initial headway) were run to and from the terminals. Additional simulations included a 50/50 mix of trains to/from 240 Street Yard. The initial (northbound) headway was reduced for each successive batch. The headway that was actually achieved was then measured. This measured headway eventually reaches a minimum, regardless of further reductions in initial northbound headway. This minimum corresponds to the terminal capacity. Refer to Table D.1-18, in which the CBTC parameters that were used, including slack protection, were identical to those used in previous NYCT modelling work.

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The new lead track would allow significantly more trains to run between Van Cortlandt Park - 242 Street station and 240 Street Yard. It would eliminate the conflict between southbound revenue trains and the slow crossing move between 240 Street Yard and the center track in 238 Street station. It would allow faster ramp-up/down for the peaks, with more trains starting/ending revenue service at Van Cortlandt Park - 242 Street rather than 238 Street.

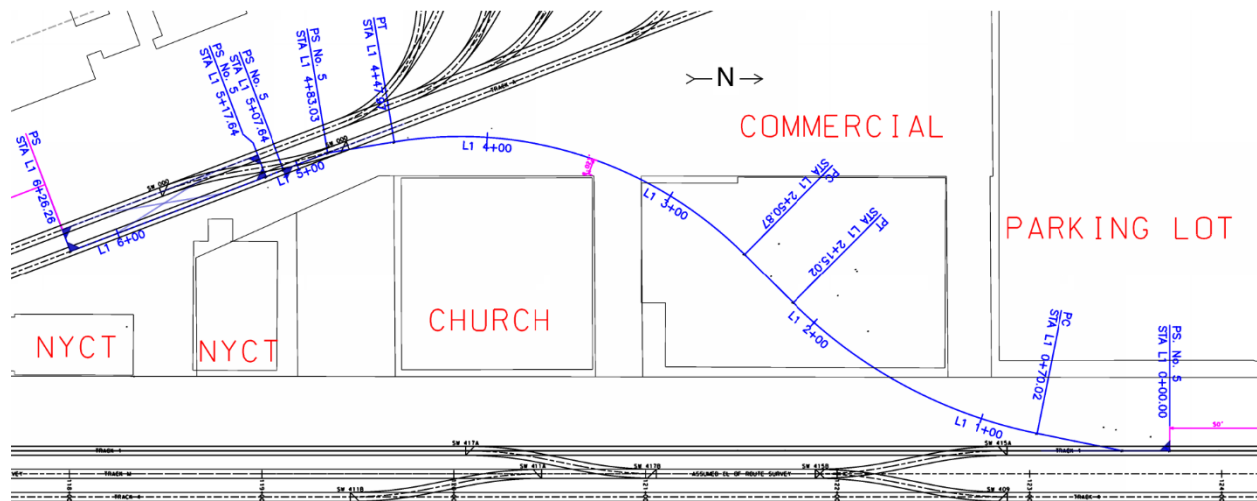
It may also be possible to simultaneously turn a second non-revenue train if required:

- It is 535 feet between the end of diamond crossover on the yard tracks and the start of the crossovers north of 238 Street.
- The space could potentially be used to turn a second train if southbound revenue trains use the center track as far as 238 Street.
- This would block trains running directly between 238 Street and 240 Street Yard but doing so may no longer be necessary.

The STV Team reviewed aerial photography of this site in Google Maps and track data from NYCT, conducted a survey of the elevated subway structure, and surveyed at street level the structures along the west side of Broadway between West 240 Street and West 242 Street. The concept for the new yard lead described would diverge from the structure south of Van Cortlandt Park – 242 Street station and continue to the yard lead, as shown in Figure D.1-32.

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Figure D.1-32. Proposed New Yard Access from Van Cortlandt Park – 242 Street



This structure would require the complete taking of the property management and real estate business and possibly a partial or complete taking of the church. Trains going from this station would not have to proceed south on Track M past the interlocking, then reverse direction for the yard move; instead, they would proceed onto the new structure to the yard lead, then reverse direction to the yard. This would remove yard moves from the main line as much as possible.

A conceptual design for the supports of this new yard lead is Figure D.1-33.

At first the STV Team considered a new track from the elevated subway structure south of Van Cortlandt Park – 242 Street station into 240 Street Yard, but this concept would have provided access only to the maintenance shop, would have had a very tight radius of curve, and would have required the complete taking of two properties: the church and the property management business. NYCT MOW Engineering noted that the proposed layout would likely be infeasible as it would not provide a direct connection to any yard tracks. A similar concept would have had a shallower radius of curve but would have led to a maximum of four storage tracks in the yard and would have required the complete taking of the church property. Either concept would have introduced the potential of conflicts at the resulting X crossing.

(ii) *Alternative Terminal Operations*

The STV Team considered the following alternatives for terminating trains bound for 240 Street Yard south of Van Cortlandt Park – 242 Street station: building a northbound island platform at 238 Street station, building a northbound island platform at 231 Street station, and building a northbound island platform at 225 Street station. In any of these cases, yard-bound trains would terminate on the middle track to allow NYCT personnel to clear the train of passengers before proceeding to the yard, without delaying trains bound for Van Cortlandt Park – 242 Street. This would also provide an additional location besides 137 Street - City College for turning trains.

Neither 238 Street station nor 231 Street station has enough clearance between the station platforms and the street for construction of a mezzanine that would enable an island platform. 225 Street station appears to have enough clearance toward its north end to accommodate a mezzanine, and on this basis the STV Team evaluated this alternative further.

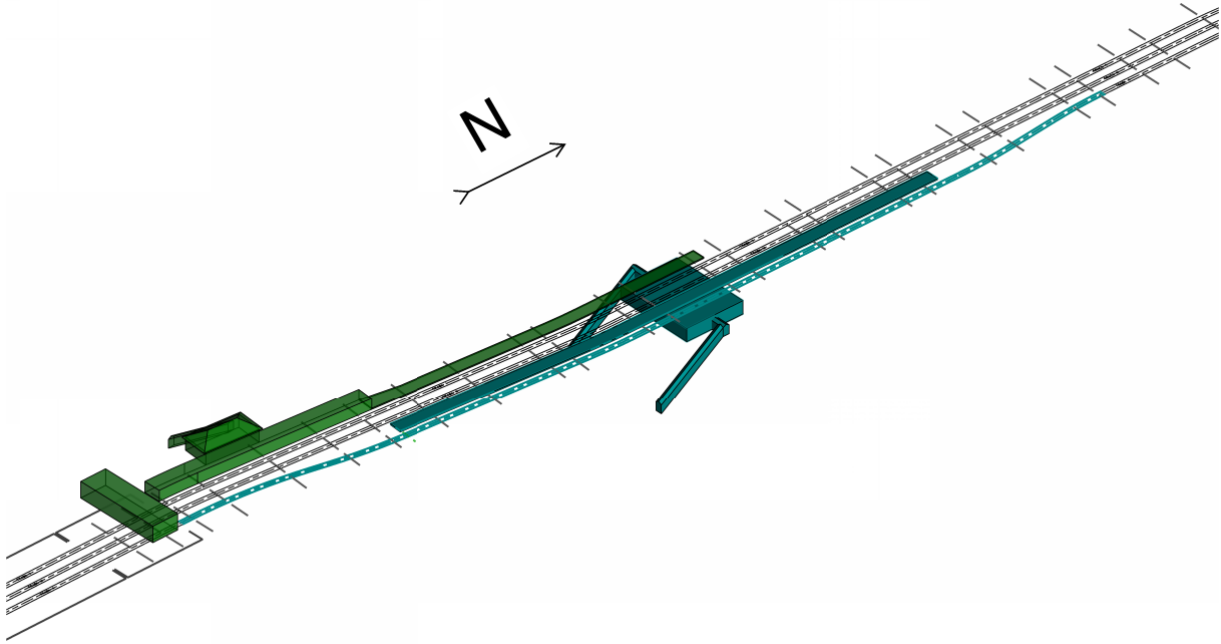
A northbound island platform would be built over the existing northbound local track way and the space occupied by the existing platform and would be offset from the southbound platform. It would be wide enough to accommodate stairs and an elevator to a mezzanine. A new northbound local track way would be built on an expansion of the existing structure. Refer to Figure D.1-34, Figure D.1-35,

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and Figure D.1-36. Northbound trains going to the yard would cross from Track 4 to Track M on an existing crossover north of 215 Street station.

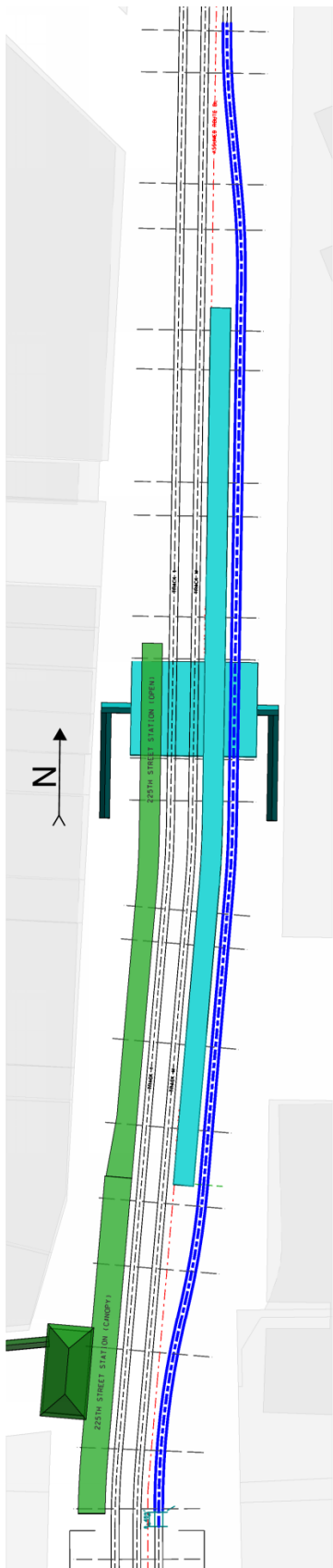
Land use in the vicinity of 225 Street station is shown in Figure D.1-37.

Figure D.1-34. Proposed Reconfiguration of 225 Street Station – Isometric (new track in blue)



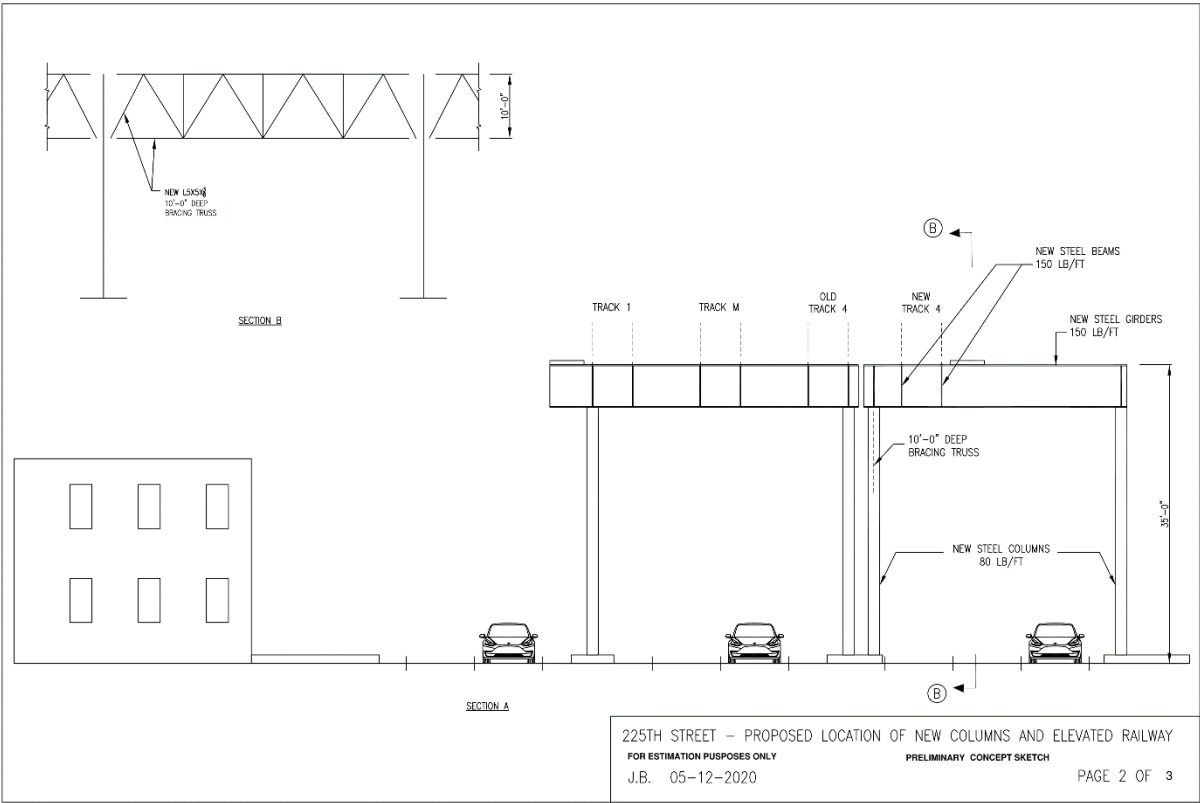
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Figure D.1-35. Proposed Reconfiguration of 225 Street Station – Plan (new track in blue)



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Figure D.1-36. Proposed Structural Concept: Reconfiguration of 225 Street Station



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Figure D.1-37. Land Use, Vicinity of 225 Street Station



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(e) *Recommendations*

The STV Team recommends no changes at this location. Constructing a new yard lead would require permanent property takings and would introduce additional noise from trains going through curves with tight radii, beyond the noise already generated by trains going to and from 240 Street Yard. While the STV Team believes constructing an island platform at 225 Street station is feasible and would fulfill the objective of simplifying terminal operations, the capital cost would be high, and the community might well oppose the required enlargement of the existing elevated structure.

The STV Team simulated the proposed island platform was but it did not improve OTP compared to the baseline CBTC model.

There would be some benefit from sweeping trains going to 240 Street Yard at Marble Hill - 225 Street, rather than at 238 Street. However, this benefit is cancelled out by additional conflicts with trains between 240 Street Yard and Van Cortlandt Park - 242 Street terminal, which turn on Track M at 238 Street.

This island platform concept is not fatally flawed but neither this nor the conceptual new yard lead passes a post-pandemic cost-benefit analysis.

D.1.4.4 Focus Area: East 180 Street

(a) *Background*

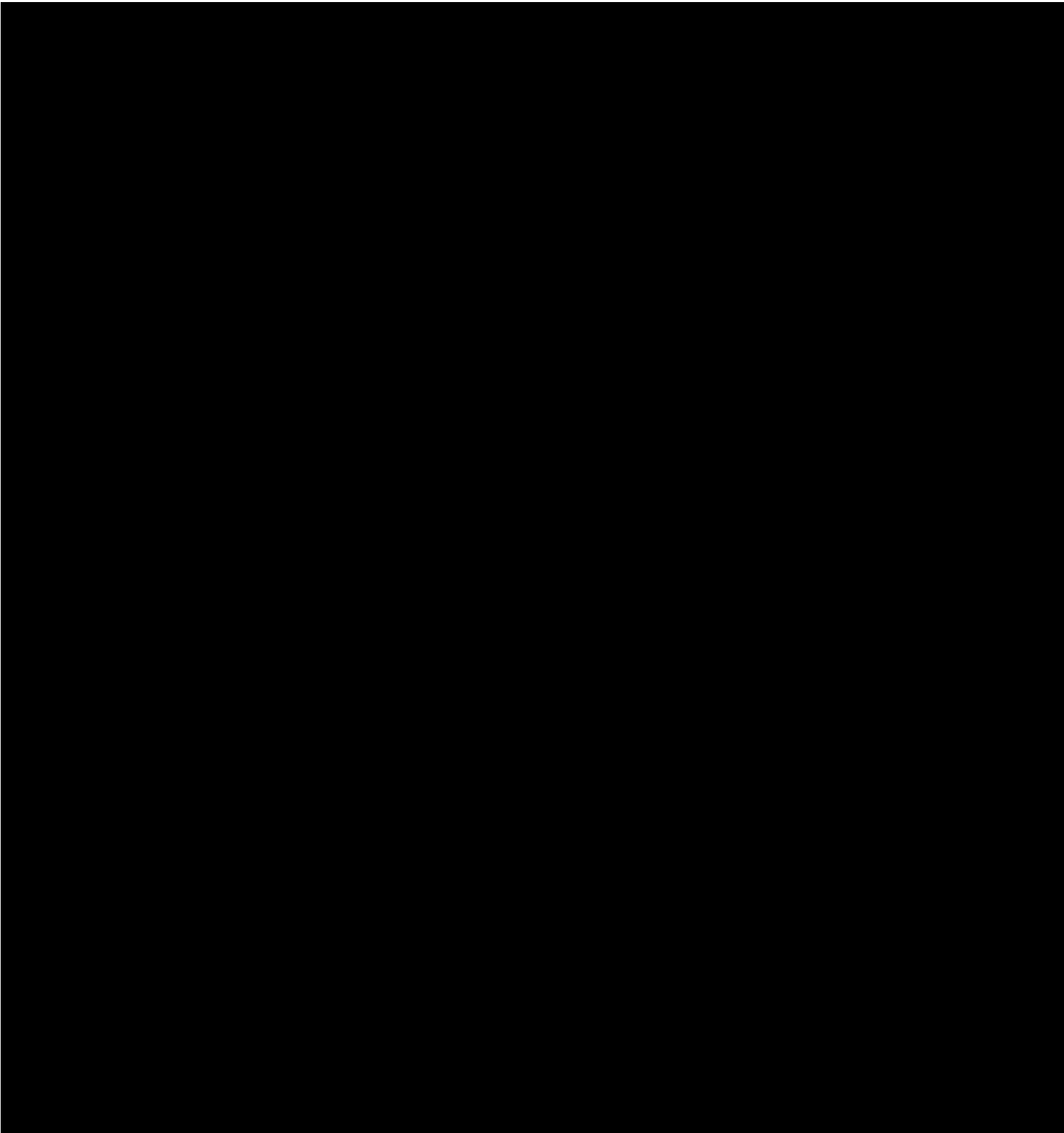
East 180 Street is an express station, north of which the Dyre Avenue line diverges from the White Plains Road line. East 180 Street Yard, west of the station, is the maintenance base for 5 Line trains and the storage yard for most 5 Line trains. Some 5 Line trains are stored at Unionport Yard, north and east of the station. North of the station, trains on both lines can enter East 180 Street Yard from the north or from the south, and trains on the 5 Line can enter Unionport Yard on Track Y2 from the north or from the south. Refer to the corresponding highlighted area in Figure D.1-31. The junction between Track W3 (all northbound 2 Line trains) and Track Y2 (most northbound 5 Line trains) is at grade north of East 180 Street station. Track Y1 (most southbound 5 Line trains) crosses over the White Plains Road main tracks W2, WM, and W3 before coming to grade between main track W2 and yard track B. Off-peak southbound 2 Line and 5 Line trains both use Track W2 south from the junction with Track Y1, as shown in Figure D.1-38.

NYCT gave the STV Team the task to explore how this conflict might be mitigated or avoided. The aim was to maximize the capacity of this very complex junction to support increased service on the Seventh Avenue line and the Lexington Avenue line.

(b) *Methodology*

The STV Team obtained double-line drawings of the main line between Bronx Park East station and East 180 Street station including the junction with the Dyre Avenue line, and of a portion of East 180 Street Yard. This purpose of this investigation was to determine whether there was a parallel track that could be used to avoid the aforesaid conflict.

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(c) Findings

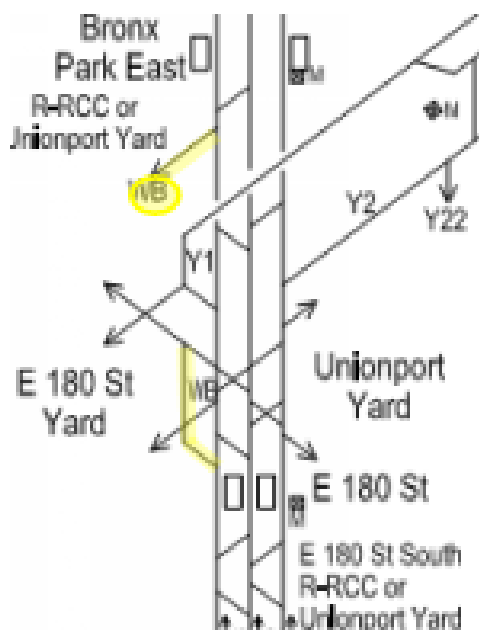
Track WB diverges from Track W2 just south of Bronx Park East station and provides access to East 180 Street Yard, then re-joins Track W2 just north of East 180 Street station. Refer to Figure D.1-39. From Track WB there are turnouts to East 180 Street Yard and a track from Track Y1 (southbound Dyre Avenue line) to the yard crosses Track WB at grade.

In the course of the study NYCT advised the STV Team that Track WB is already used for southbound peak-hour **2** Line service, albeit at a 10 MPH speed limit, to avoid conflicts with **5** Line trains.

(d) Recommendation

The STV Team recommends no track changes, or signal changes other than those required for CBTC, be made at East 180 Street as there are no peak-hour conflicts to mitigate. Such southbound off-peak conflicts as exist can be mitigated with operational improvements.

Figure D.1-39. Track WB (highlighted in yellow)



D.1.4.5 Focus Area: Nereid Avenue / Wakefield – 241 Street / 239 Street Yard

(a) Background

239 Street Yard is the storage yard and maintenance base for **2** Line and some **5** Line trains. North of the penultimate station on the line, Nereid Avenue, a two-track yard lead diverges north and east from Track WM and Track W3 on the main line. A third yard lead track diverges from the other two just east of the main line. Northbound **5** Line trains terminate at Nereid Avenue before going to the yard. **2** Line trains terminate at the last station, Wakefield - 241 Street, and to go from there to the yard must proceed south on Track WM through Nereid Avenue Station before proceeding north on the yard lead. Refer to the corresponding highlighted area in Figure D.1-31.

NYCT gave the STV Team the task to explore how moves from Wakefield – 241 Street station to 239 Street Yard might be facilitated. The aim was to measure the maximum capacity of the terminal at Wakefield – 241 Street station, anticipating implementation of CBTC.

(b) Methodology

Early in the study the STV Team considered the alternative of terminating **5** Line trains at Gun Hill Road station on the center track, allowing **2** Line trains to pass unimpeded. However, the community likely would oppose the cutback of **5** Line service, even though it occurs only at peak hours. This alternative was dropped from further consideration.

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Five scenarios were modeled for Wakefield - 241 Street, with revenue services using the outer tracks (W2, W3):

- **Scenario 1:** All trains turn at 241 Street with no yard put-ins or lay-ups.
- **Scenario 2:** 50 percent of the trains make revenue turns at 241 Street and the other 50 percent are trains from 239 Street Yard that reverse direction at Nereid Avenue and travel back to 241 Street.
- **Scenario 3:** 50 percent of the trains make revenue turns at 241 Street and the other 50 percent are trains to 239 Street Yard that reverse direction at Nereid Avenue (from 241 Street) and travel back to the yard.
- **Scenario 4:** 50 percent of the trains operating north at Nereid Avenue proceed directly to the yard, and the other 50 percent operate to 241 Street and make revenue turns.
 - A revised version of this assumes a 90-second dwell time at Nereid Avenue for yard trains, to allow the trains to be cleared of passengers before departure to the yard. The additional dwell at Nereid Avenue reduces the capacity to be comparable with Scenario 3.
- **Scenario 5:** 50 percent of the trains operating south at Nereid Avenue proceed directly from the yard, and the other 50 percent operate from 241 Street, having made revenue turns.

(c) Findings

(i) Implementation of CBTC

Table D.1-20 shows the benefits to be realized by implementing CBTC. Under trip stop signaling, the capacity in all five scenarios is relatively consistent. The extra time required for yard moves to traverse the interlocking to and from the platforms slightly reduces capacity. Yard moves that start or finish service at Nereid Avenue allow slightly more trains to be run overall, as they bypass this constraint.

The increase in capacity with CBTC varies by scenario. For put-ins from the yard to 241 Street, the time required for trains to travel from the yard to the reversal point and then back to the platform is almost as much a constraint as trip stop signaling. Yard lay-ups from 241 Street occupy the interlockings for less time than put-ins, so CBTC still would provide benefits in this case. Yard lay-ups from Nereid Avenue occupy the interlockings for much less time than put-ins, hence the greater capacity.

All revenue services were routed on the outer tracks (W2, W3), serving all stations. The center track (WM) normally is used only for turning non-revenue services heading to and from 239 Street Yard.

Headway was measured for departures from Nereid Avenue, once it had reached a stable minimum value. The headway/capacity results quoted are for the total number of trains in the direction with greater traffic: northbound for scenarios with

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revenue services and yard lay-ups, and southbound for scenarios with revenue services and yard put-ins.

Table D.1-20. Modeling of Service at Nereid Avenue / Wakefield -241 Street

Scenario	Trip stop signaling		CBTC	
	Average Simulated Headway (MM:SS)	Trains per hour	Average Simulated Headway (MM:SS)	Trains per hour
Revenue services only	2:39	22	2:16	26
Revenue services, put-ins to 241 Street	2:52	20	2:50	21
Revenue services, lay-ups from 241 Street	3:02	19	2:29	24
Revenue services, lay-ups from Nereid Avenue	2:36	23	1:45	34
Revenue services, lay-ups from Nereid Avenue, with 90-second dwell for yard trains	3:14	18	2:15	26
Revenue services, put-ins to Nereid Avenue	2:25	24	2:05	26

(ii) Access to 239 Street Yard

The only way to add access to 239 Street Yard would be to add a structure and track from yard lead track W4A north to Track W3 and converting switch 985B to a double-slip switch to give access to both terminal tracks. The new track and double-slip switch could be connected and commissioned, new signals cut over and tied in to 239 Street Relay Room, Unionport Master Tower, and the Rail Control Center, and old signals bagged and removed, with diversions on nights and weekends. This structure would have a tight radius of curve and would require a complete taking of one property and the partial taking of another. Moreover, the move from the terminal to the yard by way of this new track would conflict with northbound trains approaching the terminal. The small amount of operational convenience thus gained appears to be outweighed by the capital cost and the introduction of a conflict that does not now exist. Therefore, this alternative was dropped from further consideration.

(iii) Alternative Terminal Operations

Some trips need to originate and terminate at Nereid Avenue to meet the planned service ramp-up/ramp-down. 5 Line trains going to and from 239 Street Yard already do this. Drop-back operators for non-revenue trips would provide more trains at Wakefield – 241 Street during peak periods.

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The STV Team also examined the conversion of the existing northbound side platform at Nereid Avenue to an island platform. This would enable trains terminating at Nereid Avenue to do so on Track W3 and be cleared of passengers before proceeding to the yard, without delaying trains going to Wakefield – 241 Street. The existing northbound platform would be converted to an island platform and widened on account of the location of existing stairways. A new northbound trackway would be built outboard of the existing northbound platform for trains continuing to the terminal or to the yard, as shown conceptually, isometrically, in Figure D.1-40, and in plan in Figure D.1-41 and Figure D.1-42. Three structural options are presented: enlarging the existing northbound platform (Figure D.1-43) and two options for building a new northbound platform after demolishing the existing platform (Figure D.1-44 and Figure D.1-45). This would increase the number of revenue tracks in the station from three to four. Current land use in the area of Nereid Avenue station and 239 Street Yard is shown in Figure D.1-46.

The STV Team simulated the operational improvements that would result from this concept. Refer to Table D.1-21 for the results.

**Table D.1-21. 239 Street Yard and Wakefield – 241 Street Station:
Comparison of Terminal On-Time Performance**

Subway Line	Future Baseline CBTC	Nereid Avenue Improvements
1	93.0%	93.0%
2	93.7%	94.2%
3	90.8%	90.8%
4	98.4%	98.4%
5	94.3%	94.3%
6	97.2%	97.2%
Average	94.8%	94.9%

The simulations show that the new island platform is effective at preventing delays where northbound 2 Line trains are closely following trains that are going out of service at Nereid Avenue. The simulations show a 0.5% improvement in OTP for the 2 Line. Simulations might not capture the full benefit as perturbed operations (medical emergencies, police actions) are not reflected but may be common at this location.

In summary, this results in no changes in OTP for any other services, while the overall A-Division OTP increases by 0.1%.

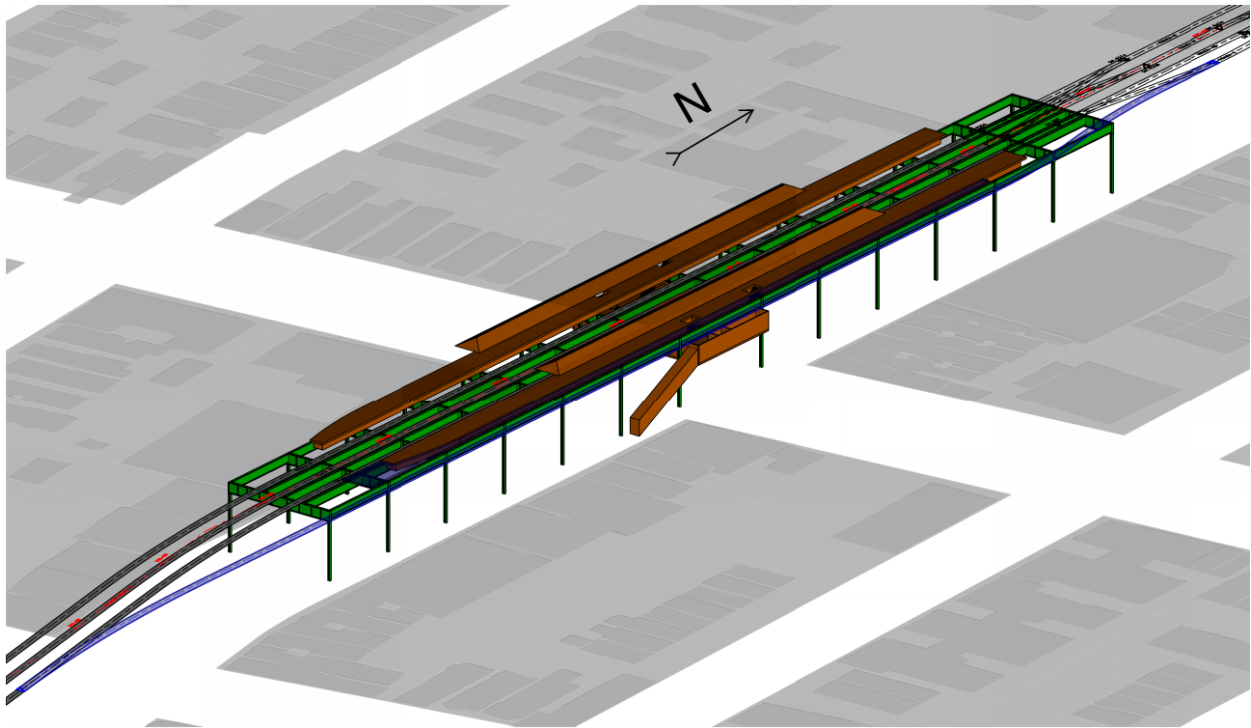
(d) Recommendations

The STV Team recommends that the existing access to 239 Street Yard be kept and NYCT assign drop-back operators at Wakefield – 241 Street station as a cost-

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effective means of speeding the transfer of trains from the terminal to the yard. The STV Team did not consider the construction cost of a new yard lead that appears to be fatally flawed by the tight radius of curve, the resulting slow operating speed over the new yard lead, property takings, and the introduction of additional noise from trains going through curves with tight radii, beyond the noise already generated by trains going to and from 239 Street Yard. While the STV Team believes constructing an island platform at Nereid Avenue station is feasible and would fulfill the objective of simplifying terminal operations, the capital cost would be high, and the community might well oppose the required enlargement of the existing elevated structure. This concept is not fatally flawed but it does not pass a post-pandemic cost-benefit analysis.

Figure D.1-40. Proposed Reconfiguration, Nereid Avenue Station – Isometric (new track in blue)



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Figure D.1-41. Proposed Reconfiguration, Nereid Avenue Station – Plan (new track in blue)

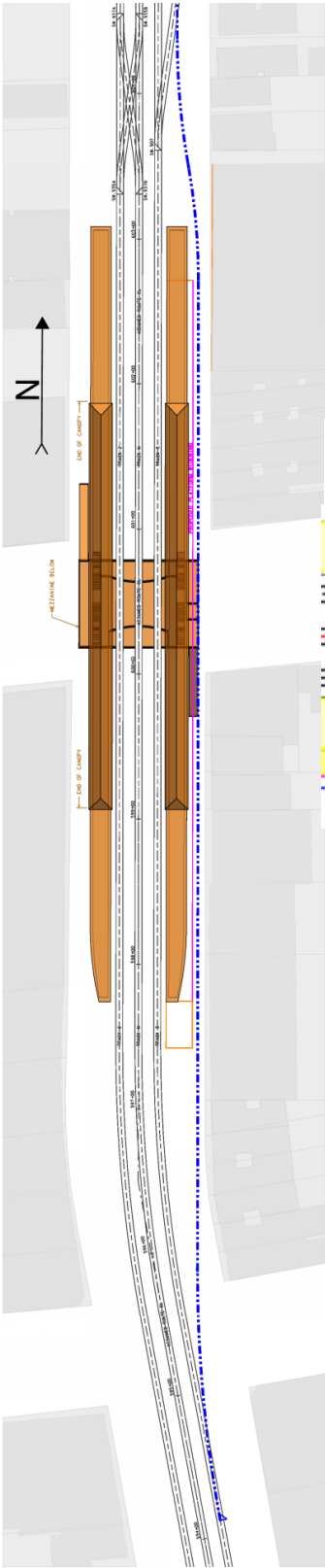
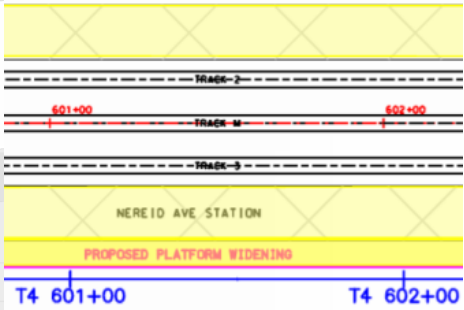
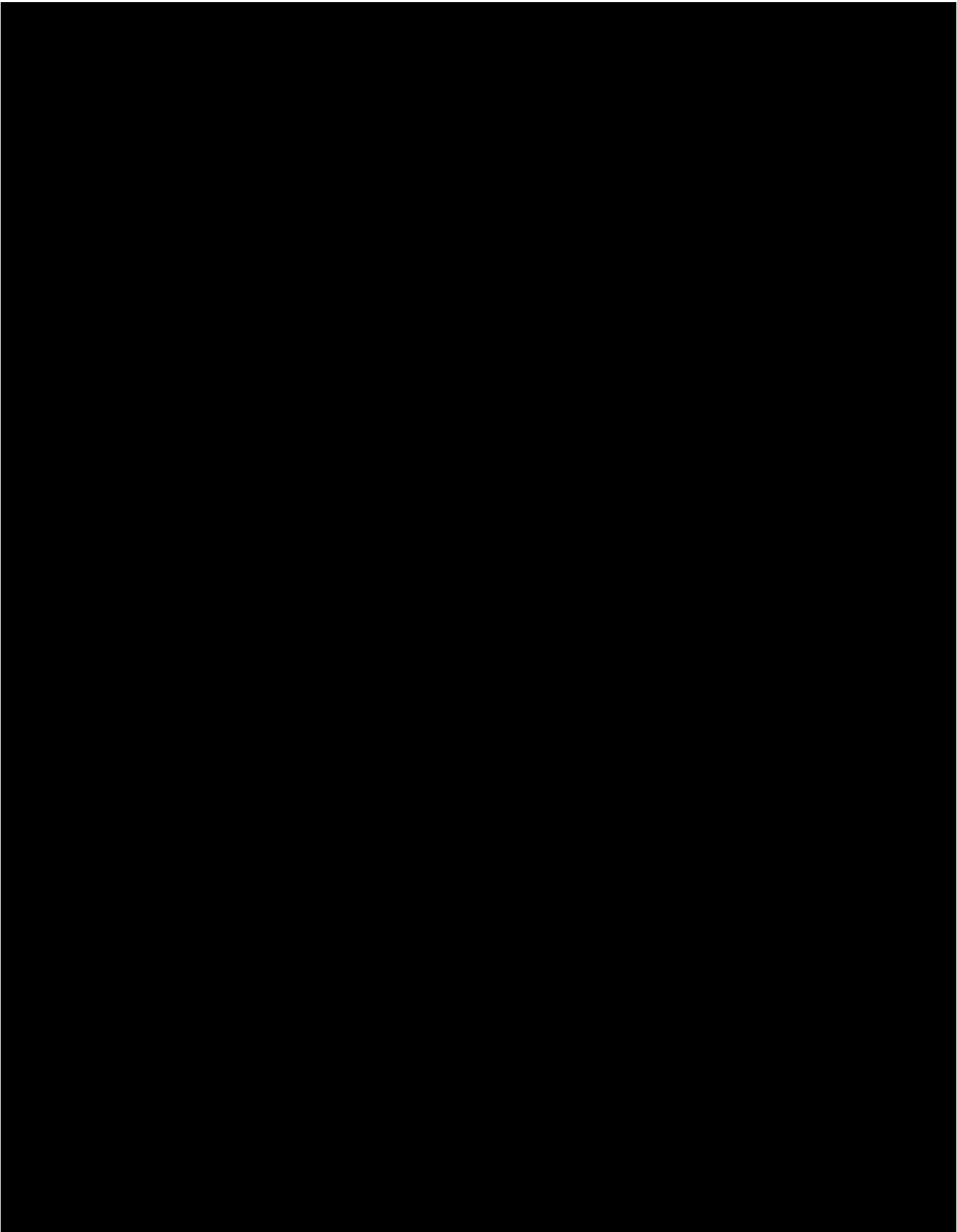


Figure D.1-42. Detail of Proposed Platform Widening at Nereid Avenue

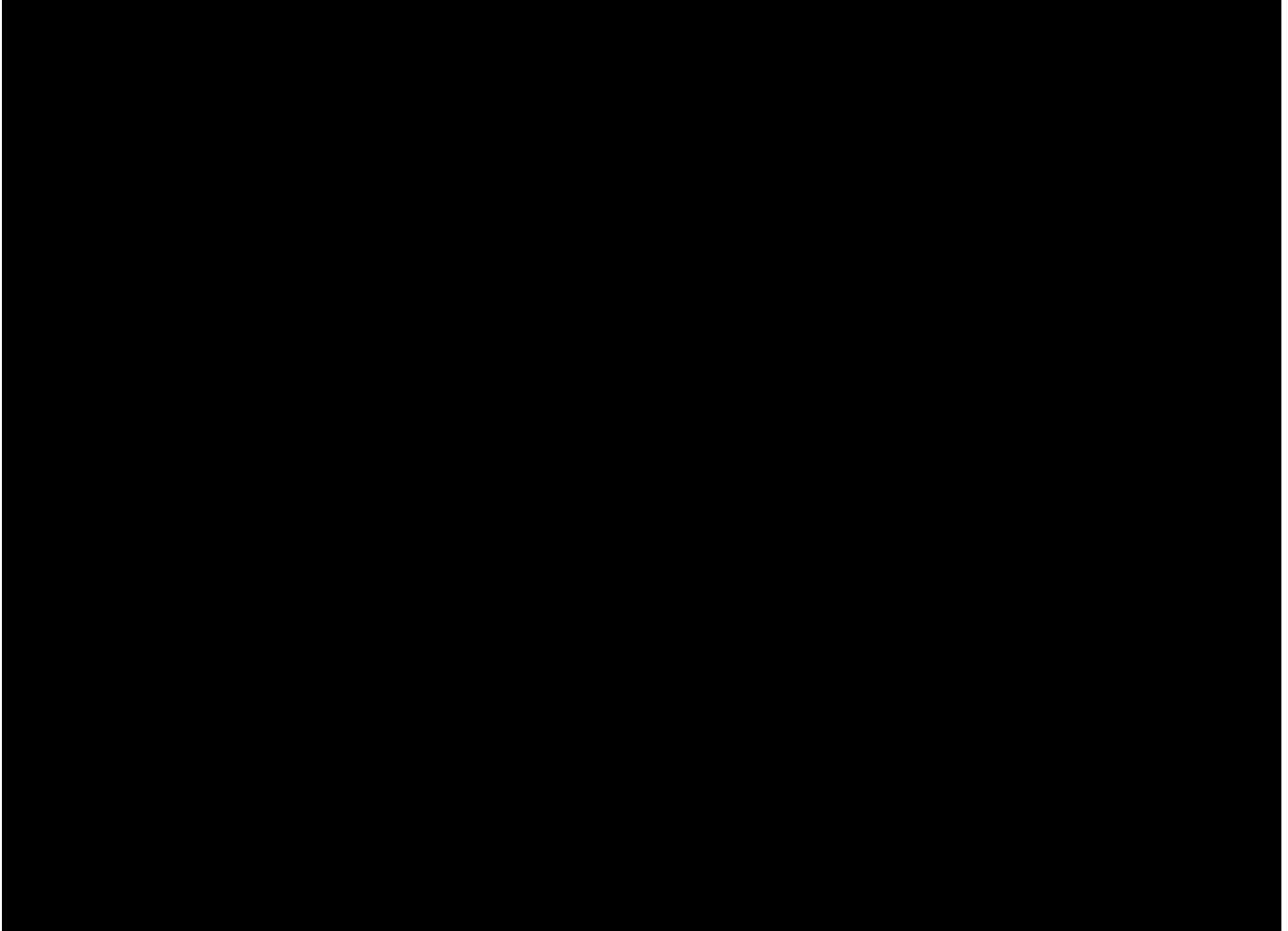


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Figure D.1-45. Proposed Reconfiguration, Nereid Avenue Station – Structural Option 3



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Figure D.1-46. Land Use, Vicinity of Nereid Avenue Station and 239 Street Yard



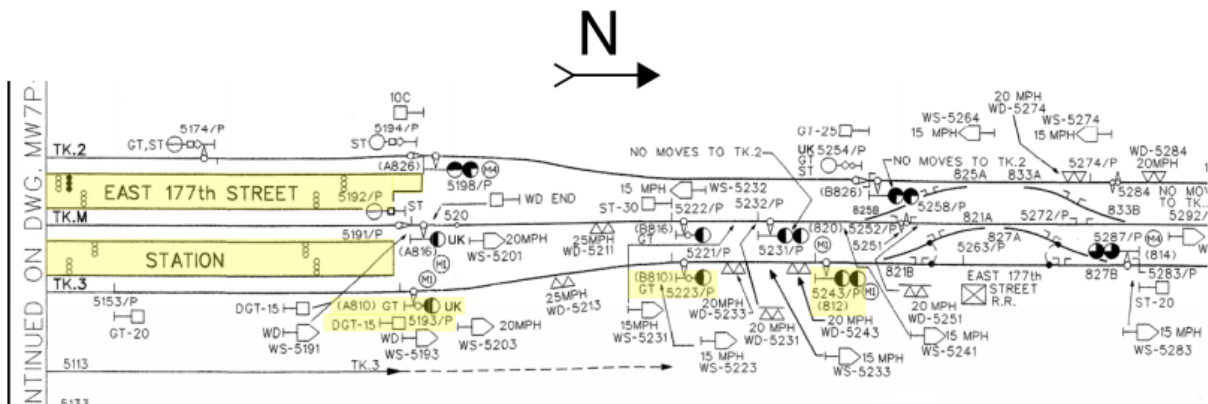
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D.1.4.6 Focus Area: Parkchester (East 177 Street)

(a) Background

Parkchester is an express station on the 6 (Pelham) Line. Refer to Figure D.1-31. Peak-hour local trains, and some weekday off-peak local trains, originate or terminate there. Additional weekday trains operate express between 3 Avenue – 138 Street and Parkchester, with one intermediate stop at Hunts Point Avenue, then continue local to Pelham Bay Park. Crossovers north of Parkchester station, shown in Figure D.1-47, are used to move trains from one track to another.

Figure D.1-47. Existing Track and Signals North of Parkchester Station



6 Line trains are stored and maintained at Westchester Yard / Pelham Maintenance Shop, north of Westchester Square station, three local stations north of Parkchester.

The STV Team has examined track and signals north and south of Parkchester station to evaluate terminal operations and moves to and from Westchester Yard. The aim was to measure the maximum capacity of the terminal operations at Parkchester, anticipating implementation of CBTC, and to address congestion at Parkchester during the morning peak.

(b) Methodology

Using NYCT single-line and double-line maps, and images from Google Earth, the STV Team was able easily to ascertain the layout of tracks and signals at Parkchester to determine operational constraints.

(c) Findings

(i) Morning Peak – Start

30 TPH southbound at the start of the morning peak, split between local Track 2 and express Track M tracks. Trains originate from Pelham Bay Park via Track 2, Westchester Yard via Track M, or are formed from northbound local trips to Parkchester that reverse north of the platforms on Track M.

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The existing crossovers north of Parkchester can support this level of service, although are close to capacity. The traffic patterns at this time are shown in Figure D.1-48.

Figure D.1-48. Traffic Patterns at Parkchester, Morning Peak (Start)



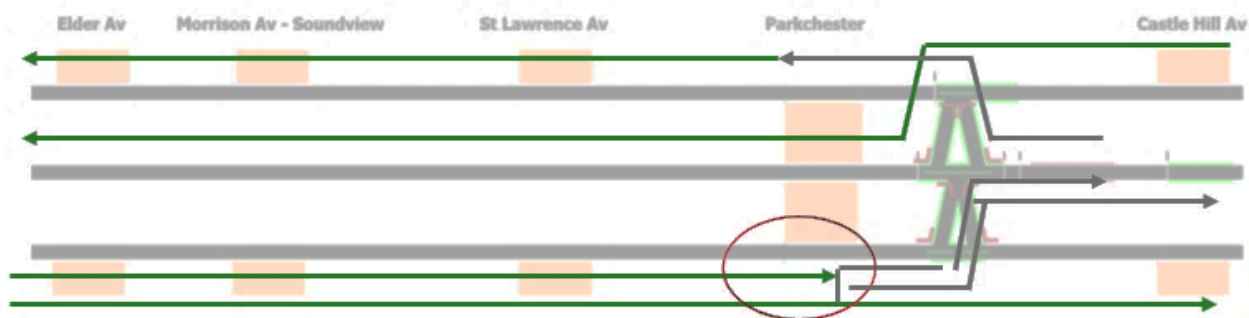
(ii) Morning Peak – End

30 TPH northbound on local Track 3 at the end of the morning peak. This is a mix of local trips to Parkchester or to Pelham Bay Park. Trains terminating at Parkchester either reverse for the return to Manhattan or go to Westchester Yard.

Trains going out of service at Parkchester must be swept in the platform on Track 3. This extends dwell times, causing some queuing and delays. Sweeping trains (for 90 seconds) in the platform at Parkchester at the end of the morning peak is the most significant constraint on the future baseline (CBTC) operating plan for the **6** Line.

The traffic patterns at this time are shown in Figure D.1-49.

Figure D.1-49. Traffic Patterns at Parkchester, Morning Peak (End)



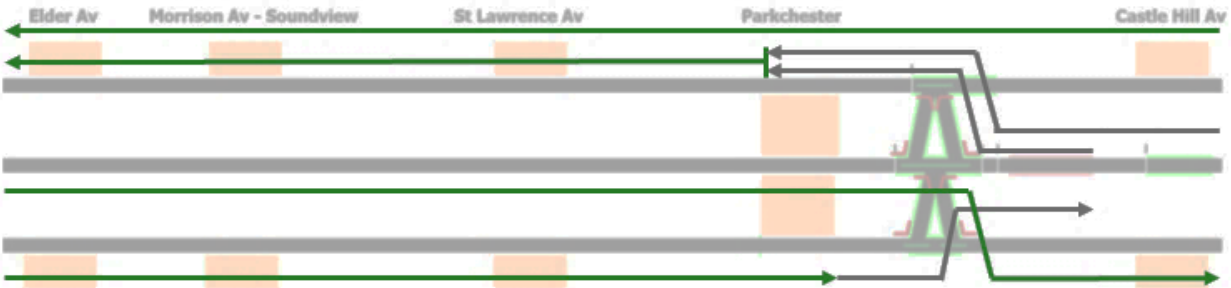
(iii) Evening Peak - Start

30 TPH southbound at the start of the evening peak, all on local Track 2. The origins of these trips follow the morning peak pattern. Northbound trips are a mix of express trips to Pelham Bay Park and local trips to Parkchester. As before, the existing crossovers can support this level of service.

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The traffic patterns at this time are shown in Figure D.1-50.

Figure D.1-50. Traffic Patterns at Parkchester, Evening Peak (Start)



(iv) Evening Peak - End

30 TPH northbound at the end of the p.m. peak is split between local Track 3 and express Track M. Express trips continue to Pelham Bay Park, while local trips reverse north of the station.

15 TPH on Track 3 provides enough time to sweep trains in the platform without causing congestion.

The traffic patterns at this time are shown in Figure D.1-51.

Figure D.1-51. Traffic Patterns at Parkchester, Evening Peak (End)

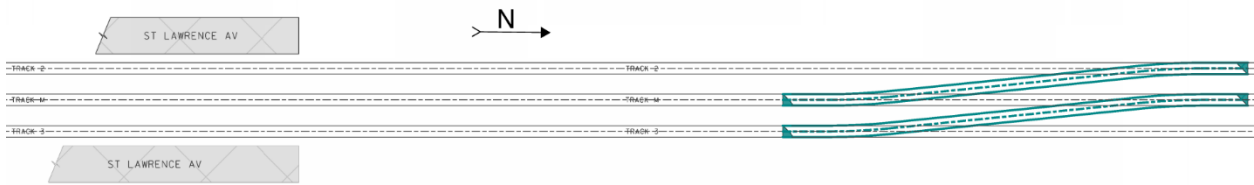


(a) Recommendation

The STV Team recommends implementation of two new parallel #10 crossovers south of Parkchester station as shown in Figure D.1-52 while preserving the existing crossovers north of Parkchester station. Taken together, this would provide additional capacity and operational flexibility. A new relay room would have to be built near the new crossovers. The new crossovers could be connected and commissioned, new signals cut over and tied-in to the new relay room, Westchester Master Tower, and the Rail Control Center, and old signals bagged and removed, with diversions on nights and weekends. For a preliminary budgetary construction cost estimate refer to Paragraph H.1.4.

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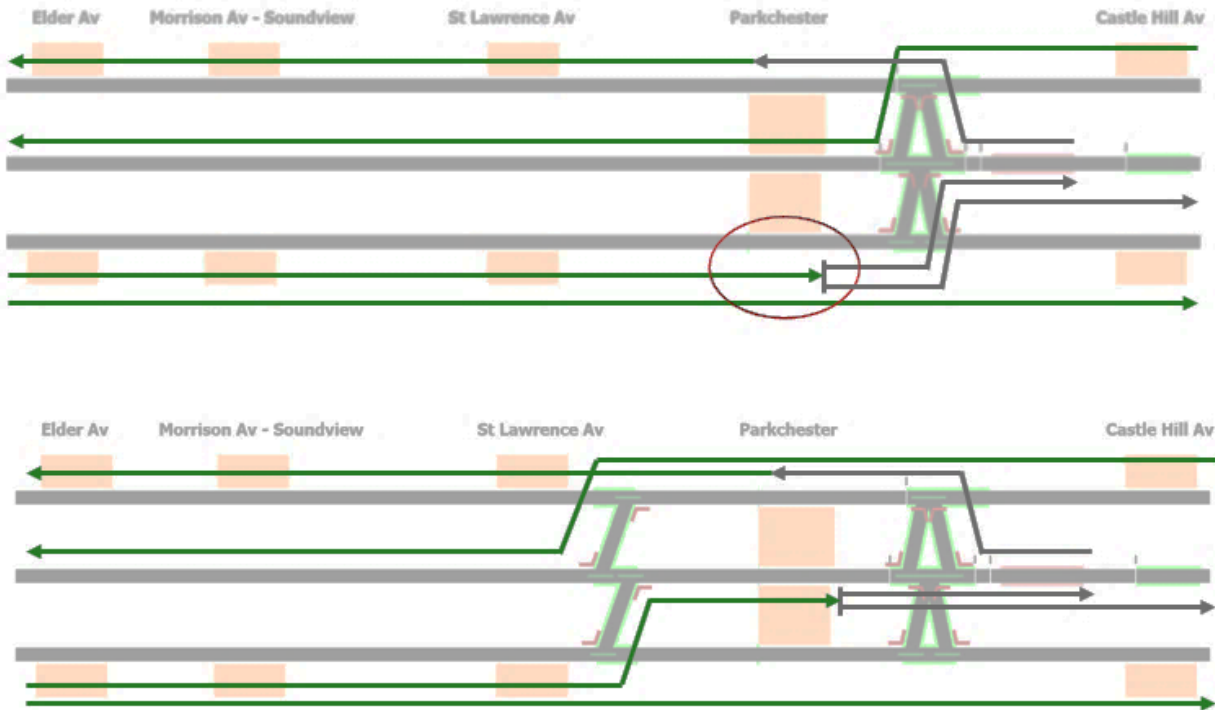
Figure D.1-52. Proposed New Crossovers South of Parkchester Station



(i) Summary of Proposed Change: Morning Peak Routes

The effect of the proposed new crossovers south of Parkchester station is summarized in Figure D.1-53, in which the upper diagram is the same as Figure D.1-49 and the lower diagram shows traffic patterns with the new crossovers. There are no changes to the point-to-point scheduled times or the overall operating plan, only to the platform assignments at Parkchester.

Figure D.1-53. Revised Morning Peak Routes, Parkchester Station



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(i) Comparison of Terminal On-Time Performance

This improvement would have a beneficial effect on performance of the 6 Line and all six lines included in this study over the Future CBTC Baseline. Refer to Table D.1-22 and Table D.1-23.

Table D.1-22. Parkchester Station: Comparison of Terminal On-Time Performance

Subway Line	Future Baseline CBTC	Parkchester Improvements
1	93.0%	93.0%
2	93.7%	93.7%
3	90.8%	90.8%
4	98.4%	98.4%
5	94.3%	94.3%
6	97.2%	99.5%
Average	94.8%	95.4%

Table D.1-23. Parkchester Station Average Travel Time Comparison

Future CBTC Baseline									
	Northbound			Southbound			Overall		
	Min	Max	Average	Min	Max	Average	Min	Max	Average
AM	0:54:23	0:59:56	0:57:48	0:48:58	0:51:33	0:49:46	0:48:58	0:59:56	0:53:50
PM	0:50:25	0:54:37	0:51:51	0:54:25	0:57:42	0:55:47	0:50:25	0:57:42	0:53:51
Both	0:50:25	0:59:56	0:54:52	0:48:58	0:57:42	0:52:49	0:48:58	0:59:56	0:53:50
Parkchester Improvements									
	Northbound			Southbound			Overall		
	Min	Max	Average	Min	Max	Average	Min	Max	Average
AM	0:54:23	0:59:56	0:57:30	0:48:39	0:51:13	0:49:52	0:48:39	0:59:56	0:53:41
PM	0:50:25	0:52:20	0:51:28	0:54:40	0:57:49	0:55:57	0:50:25	0:57:49	0:53:41
Both	0:50:25	0:59:56	0:54:27	0:48:39	0:57:49	0:52:55	0:48:39	0:59:56	0:53:41

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The proposed introduction of new crossovers south of Parkchester station would increase OTP on the 6 Line from 97.2% to 99.5%. Systemwide OTP would increase from 94.8% to 95.4%. Overall average 6 Line travel times are reduced by around ten seconds.

Reductions in northbound travel time more than make up for small increases in southbound travel time.

D.1.4.7 Focus Area: Pelham Bay Park

(a) Background

Pelham Bay Park station is the northern terminus of the 6 Line. Peak hour express trains originate and terminate there, as do most weekday off-peak local trains and all weekend trains.

6 Line trains are stored and maintained at Westchester Yard / Pelham Maintenance Shop, south of Middletown Road station, two local stations south of Pelham Bay Park.

The STV Team has examined track and signals in the area of Pelham Bay Park station to evaluate terminal operations and moves to and from Westchester Yard. The aim was to measure the maximum capacity of the terminal at Pelham Bay Park station, anticipating implementation of CBTC.

(b) Methodology

Figure D.1-54. Findings at Pelham Bay Park

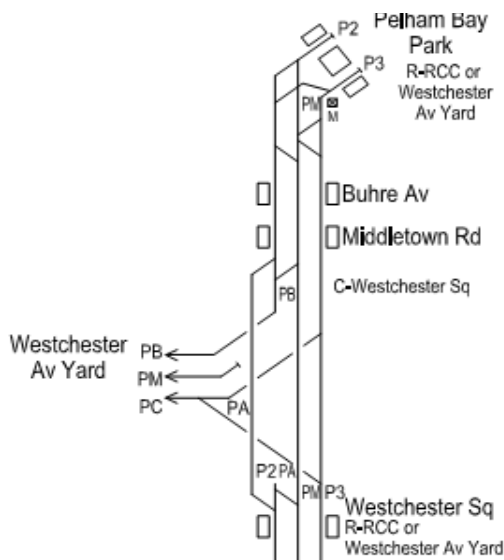
Using NYCT single-line and double-line maps, and images from Google Earth, the STV Team was able easily to ascertain the layout of tracks and signals at Pelham Bay Park to determine operational constraints.

(c) Findings

Trains terminating at Pelham Bay Park and making a southbound non-revenue run can cross to Track M and proceed to the yard. The leads to Westchester Yard are fully grade-separated and the yard is accessible from both north and south. Refer to Figure D.1-54.

(d) Recommendation

There does not appear to be a capacity constraint at Pelham Bay Park station. Revenue trains and trains going to and from the yard do not appear to interfere with each other. Therefore, no track changes, or signal changes other than those required for CBTC, are recommended at this location.





IRT CAPACITY STUDY

1 2 3 4 5 6 S LINES

***E - CBTC "SUPER MODEL" SIMULATION
TECHNICAL MEMORANDUM***



Prepared for:



by:
STV

**Document Number: LTK.C4855.05.01
June 2020**

CBTC “SUPER MODEL” SIMULATION TECHNICAL MEMORANDUM

E.0 Revision History

Revision No.	Date	Description of Revision
0	June 22, 2020	Initial Draft Release
1	July 31, 2020	Final Release

CBTC “SUPER MODEL” SIMULATION TECHNICAL MEMORANDUM

E.1 Summary

Following the completion of CBTC Future Baseline network simulation analysis, a “Super Model” was developed which includes infrastructure improvements selected by NYCT to address previously identified capacity choke points. Improvements were modeled at the following locations:

- New Lots Avenue
- Flatbush Avenue - Brooklyn College
- Crown Heights - Utica Avenue
- Grand Central - 42 Street
- Parkchester

The “Super Model” was evaluated under both the Future Baseline CBTC operating plan as well as a Hybrid operating plan, described in paragraph E.2.2.2, which straight-rails service through Nostrand Junction and introduces a new **8** Line service operating between Wakefield - 241 Street and New Lots Avenue. The Future Baseline CBTC operating plan increases peak service delivery versus today’s service levels while the Hybrid operating plan adds still more service on the West Side Lines between the Bronx and Brooklyn.

“Super Model” results include end terminal on-time performance and peak service delivery (simulated versus scheduled). Apart from the infrastructure improvements and operating plan differences discussed in Section E.2, all simulation inputs and parameters are identical to those of the CBTC Future Baseline model.

Table E.1-1 compares on-time performance between the Existing (wayside) Baseline, CBTC Future Baseline, and “Super Models” under both Future Baseline and Hybrid operating plans.

The **2** Line and **8** Line on-time performance decreases in the “Super Model” with Hybrid operating plan as a result, but with no cascading effects on the **3** Line, **4** Line, and **5** Line. This can be attributed partly to congestion at Wakefield - 241 Street, which turns 18 TPH for the **2** Line and **8** Line under the Hybrid operating plan but only 13 TPH under the Future Baseline operating plan.

Poorer on-time performance can also be attributed partly to congestion at New Lots Avenue, which turns 16 TPH for the **5** Line and **8** Line under the Hybrid operating plan but only 13 TPH for the **3** Line under the Future Baseline operating plan. As discussed in paragraph C.3.6.3, New Lots Avenue with crossover improvements has a practical CBTC capacity of 20 revenue turns plus 6 yard put-ins per hour.

6 Line on-time performance increases significantly under both “Super Models” as a result of reduced congestion facilitated by the proposed crossovers south of Parkchester that are described in paragraph D.1.4.6.

CBTC “SUPER MODEL” SIMULATION TECHNICAL MEMORANDUM

Table E.1-1. Comparison of Simulated Full Day On-Time Performance by Line

Subway Line	Wayside Simulated	Phases I-IV CBTC Base Op Plan Simulated	Super Model CBTC Base Op Plan Simulated	Super Model CBTC Hybrid Op Plan Simulated
1	92.4%	93.0%	93.0%	93.0%
2 8 *	81.2%	93.7%	94.5%	88.1%
3	93.1%	90.8%	93.8%	99.1%
4	91.6%	98.4%	98.9%	99.0%
5	93.0%	94.3%	95.3%	98.6%
6	90.6%	97.2%	99.8%	99.8%
Average	90.5%	94.8%	96.1%	95.8%

Subway Line	Wayside Simulated	Phases I-IV CBTC Base Op Plan Simulated	Super Model CBTC Base Op Plan Simulated	Super Model CBTC Hybrid Op Plan Simulated
S	100.0%	100.0%	100.0%	100.0%

Note: Super Model Hybrid Plan 8 Line results are included with the 2 Line

Table E.1-2 compares both peak service delivery and on-time performance between the CBTC Future Baseline and both “Super Models” under the Future Baseline and Hybrid operating plans.

Table E.1-2. Comparison of Simulated Terminal On-Time Performance and Peak Service Delivery by Line

	Phases I-IV CBTC Base Operating Plan Simulated		Super Model CBTC Base Operating Plan Simulated		Super Model CBTC Hybrid Operating Plan Simulated	
Subway Line	Scheduled TPH	OTP	Scheduled TPH	OTP	Scheduled TPH	OTP
1	30	93.0%	30	93.0%	30	93.0%
2 8 *	13	93.7%	13	94.5%	12 / 6	88.1%
3	13	90.8%	13	93.8%	12	99.1%
4	23	98.4%	23	98.9%	20	99.0%
5	7	94.3%	7	95.3%	10	98.6%
6	30	97.2%	30	99.8%	30	99.8%
Combined	116	94.8%	116	96.1%	120	95.8%

	Phases I-IV CBTC Base Operating Plan Simulated		Super Model CBTC Base Operating Plan Simulated		Super Model CBTC Hybrid Operating Plan Simulated	
Subway Line	Scheduled TPH	OTP	Scheduled TPH	OTP	Scheduled TPH	OTP
S	20	100%	20	100%	20	100%

Note: Super Model Hybrid Plan 8 Line results are included with the 2 Line

E.2 “Super Model” Proposed Improvements

The “Super Model” contains several infrastructure improvements that aim to address capacity chokepoints identified in the Future Baseline CBTC network simulation model. The “Super Model” was also evaluated under the Future Baseline CBTC operating plan as well as a Hybrid operating plan that delivers a higher combined TPH throughout the network.

E.2.1 Proposed Infrastructure Improvements

E.2.1.1 *New Lots Avenue Improvements*

Infrastructure improvements at New Lots Avenue involve replacing the existing #6 AREMA universal crossover north of New Lots Avenue terminal (revenue-side), which currently supports diverging speeds of 12 MPH. The newly installed diamond #10 tangential crossover would facilitate diverging speeds of 26.5 MPH (de-rated to 25 MPH).

As discussed in paragraph C.3.6.3, the proposed crossover improvement at New Lots Avenue improves practical terminal capacity from 23 TPH (CBTC operation) to 32 TPH when handling revenue turns only. When handling both revenue turns and 6 TPH yard put-ins, practical terminal capacity improves from 18 TPH revenue turns plus 6 TPH yard put-ins to 20 TPH revenue turns plus 6 TPH yard put-ins.

E.2.1.2 *Flatbush Avenue - Brooklyn College Improvements*

Infrastructure improvements at Flatbush Avenue - Brooklyn College involve replacing the existing diamond #8 AREMA crossover north of the station, which currently supports diverging speeds of 15 MPH. The newly installed diamond #10 tangential crossover would facilitate diverging speeds of 26.5 MPH (de-rated to 25 MPH). An unrelated Flatbush Avenue - Brooklyn College terminal improvement that involves a short extension of tracks south of the station to provide a CBTC buffer overrun was not included in the “Super Model” due to earlier study results revealing the superior capacity gains of the new crossovers.

As discussed in paragraph C.3.6.1, the proposed crossover improvement at Flatbush Avenue - Brooklyn College increases practical terminal capacity from 31 TPH (CBTC only) to 34 TPH in situations where 2 and 5 services can use either platform. The improved revenue side crossovers increase practical terminal capacity with CBTC from 25 TPH to 26 TPH under the assumption of assigned platforms for 2 and 5 services.

E.2.1.3 *Crown Heights - Utica Avenue Improvements*

Infrastructure improvements at Crown Heights - Utica Avenue involve installing two new #12 tangential crossovers between Tracks E1 and E2 just north of the upper level platform. The new crossovers would facilitate diverging speeds of 32 MPH, de-rated to 30 MPH.

The installation of new crossovers facilitates alternate service patterns under the Hybrid Operating Plan, as discussed in Section E.2.2.2.

CBTC “SUPER MODEL” SIMULATION TECHNICAL MEMORANDUM

E.2.1.4 Grand Central - 42 Street Improvements

As discussed in paragraph C.3.3.2, CBTC treats the lengthy interlocking immediately north of Grand Central - 42 Street as one fixed block. ④ Line and ⑤ Line trains therefore experience congestion entering the station while waiting for the preceding train to clear both the platform and interlocking. As a result, Grand Central - 42 Street is the primary capacity constraint for Lexington Avenue express service, with northbound express service limited to 29 TPH during the PM peak period.

Infrastructure improvements at Grand Central - 42 Street result in a subdivided interlocking consisting of a diamond crossover between the express tracks north of the northbound platform, followed by two sets of diamond crossovers on the northbound and southbound express/local track pairs. All crossovers are #6 AREMA turnouts. Two sets of home signals separate the interlockings, reducing the overall length of the interlocking's fixed block constraint.

To determine the effectiveness of the proposed improvement, a crush capacity analysis was performed in which the northbound Lexington Avenue express track was subject to 40 TPH operation. The resulting throughput was then de-rated by 10 percent to obtain a practical track capacity. The maximums of the a.m. and p.m. peak period dwell times were applied at each station, as defined in paragraph G.1.3.4. The analysis was conducted on both the existing and proposed infrastructure with results shown in Table E.2-1.

Table E.2-1. Grand Central - 42 Street Crush Capacity Analysis

	Nevins St	Borough Hall	Bowling Green	Wall St	Fulton St	Brooklyn Bridge	14 St-Union Sq	Grand Central-42 St	59 St	86 St	125 St	Trains per Hour
	Northbound Dwell Times – Max of AM/PM Peaks (seconds)											
Existing Layout	30	35	35	30	35	30	45	55	35	35	45	26.4
Proposed Layout	30	35	35	30	35	30	45	55	35	35	45	28.8

The crush capacity analysis exhibits a 2 TPH capacity increase on the northbound Lexington Avenue express track when the interlocking north of the station is subdivided and the fixed block capacity constraint is mitigated.

Note that the throughputs under both the existing and proposed layouts are lower than the 29 TPH obtained during the Future Baseline CBTC full network simulation results. This is attributed to the fact that the maximum of the a.m. and p.m. peak period dwell times was conservatively applied at each station. The “Super Model” full network simulation results are not subject to this conservative application of dwell times and thus exhibit a higher throughput than the 28.8 TPH shown in To determine the effectiveness of the proposed improvement, a crush capacity analysis was performed in which the northbound Lexington Avenue express track was subject to 40 TPH operation. The resulting throughput was

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then de-rated by 10 percent to obtain a practical track capacity. The maximums of the a.m. and p.m. peak period dwell times were applied at each station, as defined in paragraph G.1.3.4. The analysis was conducted on both the existing and proposed infrastructure with results shown in Table E.2-1.

E.2.1.5 Parkchester Improvements

Infrastructure improvements at Parkchester involve the installation of new parallel single #10 tangential crossovers between Track 2 and Track M as well as between Track 3 and Track M north of St Lawrence Avenue. The intent of the new crossovers is to improve turnback operations of 6 Line trains, especially in the morning peak period, under future CBTC operations with a 30 TPH service level. The crossovers are conceptually designed and modeled north of St Lawrence Avenue and not closer to Parkchester due to a 1.7 percent grade immediately south of the Parkchester platform.

E.2.2 Proposed Operating Plans (CBTC)

E.2.2.1 Future Baseline Operating Plan

The “Super Model” is evaluated under the Future Baseline CBTC operating plan that is discussed in paragraph G.1.3.

The Future Baseline plan developed by the STV Team, Part C of this report, recognizes Nostrand Junction as one of the critical A-Division bottlenecks. Because of the track layout, the total of 2 Line, 3 Line, and 5 Line service to Flatbush Avenue – Brooklyn College and on the local track to Crown Heights - Utica Avenue cannot exceed 33 TPH. The resultant peak period train volumes are:

- 1 Line – 30 TPH
- 2 Line – 13 TPH
- 3 Line – 13 TPH
- 4 Line – 23 TPH
- 5 Line – 7 TPH, and
- 6 Line – 30 TPH

This results in the combined 2 Line and 3 Line at 26 TPH, the combined 4 Line and 5 Line at 30 TPH and the 1 Line and 6 Line each at 30 TPH. The future baseline plan schedules the 30 TPH volume for at least two hours in the peak – approximately 7 a.m. to 9 a.m. and 4:30 a.m. to 6:30 p.m.

E.2.2.2 Hybrid Operating Plan

The “Hybrid” CBTC operating plan eliminates the bottleneck at Nostrand Junction by straight-railing service such that 2 Line and 3 Line service operates local to Flatbush Avenue - Brooklyn College and the 4 Line and 5 Line operate express to Crown Heights

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- Utica Avenue and New Lots Avenue. As seen in Figure E.2-1, the 5 Line service utilizes the newly installed crossovers north of Crown Heights - Utica Avenue to operate express to Crown Heights - Utica Avenue and local to New Lots Avenue.

A new 8 Line service is also introduced as an input, operating from Wakefield - 241 Street to New Lots Avenue, running express in Manhattan and local in the Bronx and Brooklyn. The newly proposed 8 Line is the only service to Nostrand Avenue and Kingston Avenue stations in the “Hybrid” operating plan. The peak period train volumes resulting from these inputs to the model are:

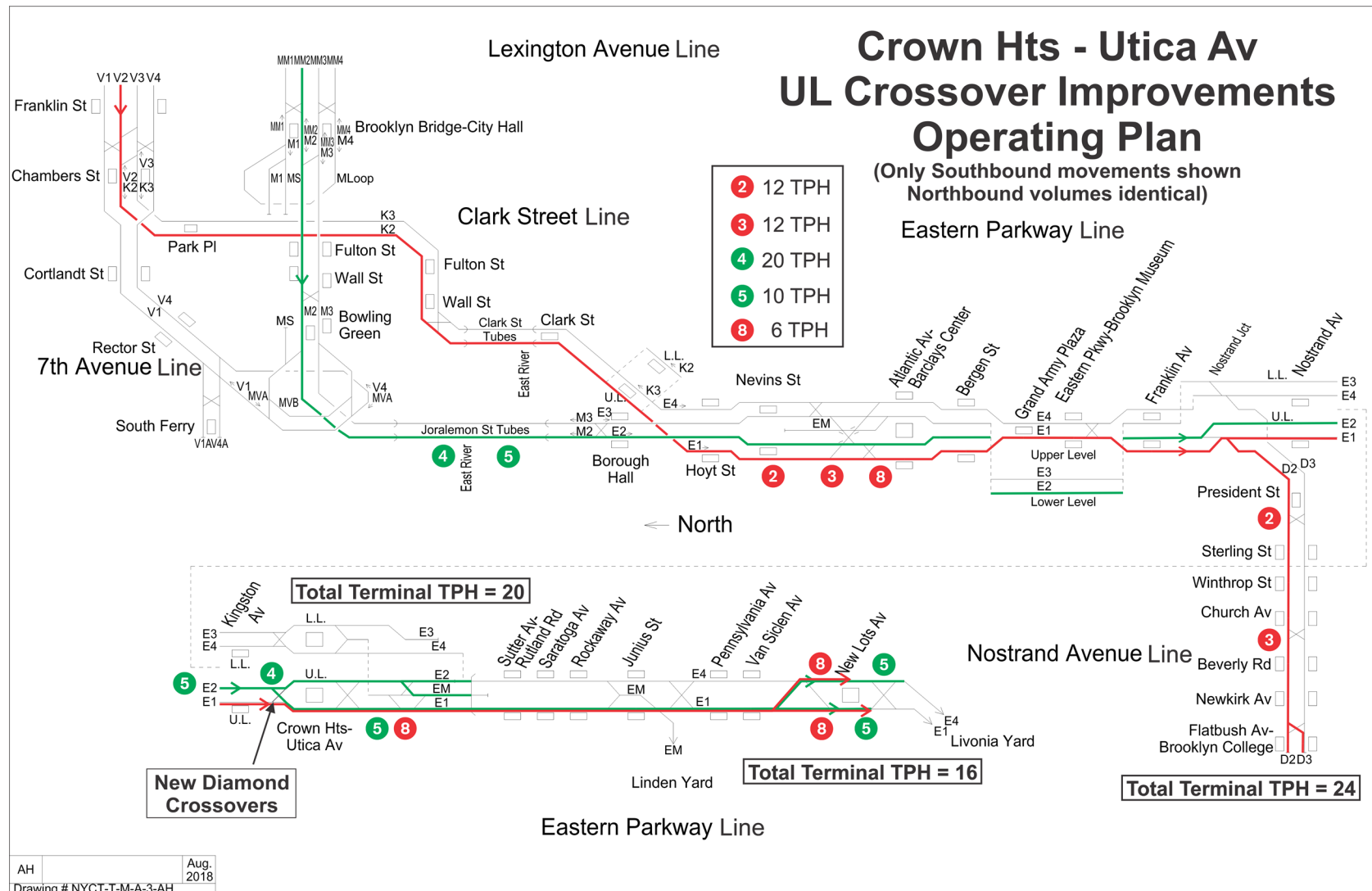
- 1 Line – 30 TPH
- 2 Line – 12 TPH
- 3 Line – 12 TPH
- 4 Line – 20 TPH
- 5 Line – 10 TPH
- 6 Line – 30 TPH, and
- 8 Line – 6 TPH

This results in the combined 2 Line, 3 Line, and 8 Line at 30 TPH, the combined 4 Line and 5 Line at 30 TPH, and the 1 Line and 6 Line each at 30 TPH.

Under the Hybrid Operating Plan, the Nostrand Avenue and Kingston Avenue stations on the Eastern Parkway line are serviced by 6 TPH, a decrease from 13 TPH under the Future Baseline operating plan. As part of the A-Division Study, NYCT Operations Planning evaluated evening peak period egress queueing at this reduced service level and found that the two stations’ pedestrian flow capacities are capable of handling more concentrated volumes of passengers.

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Figure E.2-1. Hybrid Operating Plan



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E.3 “Super Model” (CBTC) Results – Future Baseline Operating Plan

“Super Model” simulation results under the Future Baseline operating plan include end terminal on-time performance and peak service delivery (simulated versus scheduled). Apart from the infrastructure improvements discussed in Section E.2.1, all simulation inputs and parameters are identical to those of the CBTC Future Baseline model.

E.3.1 On-Time Performance

Table E.3-1 displays “Super Model” (CBTC) on-time performance for each line under the Future Baseline operating plan for three different end terminal lateness thresholds. Using a five-minute lateness threshold, the overall simulation shows a 96.1 percent OTP, an improvement over 94.8 percent in the CBTC Future Baseline model.

Table E.3-1. Simulated Terminal On-Time Performance by Line – Future Baseline Operating Plan

Lateness Threshold	00:00:00		00:05:00		00:10:00		All Stops	
Subway Line	Trips	Pct (%)	Trips	Pct (%)	Trips	Pct (%)	Trips	Pct (%)
1	148	23.1%	597	93.0%	641	99.8%	642	100%
2	120	33.0%	344	94.5%	361	99.2%	364	100%
3	87	25.8%	316	93.8%	337	100%	337	100%
4	264	59.3%	440	98.9%	445	100%	445	100%
5	206	68.9%	285	95.3%	299	100%	299	100%
6	443	68.8%	643	99.8%	644	100%	644	100%
Combined	1268	46.4%	2625	96.1%	2727	99.9%	2731	100%
Lateness Threshold	00:00:00		00:05:00		00:10:00		All Stops	
Subway Line	Trips	Pct (%)	Trips	Pct (%)	Trips	Pct (%)	Trips	Pct (%)
S	282	50.0%	564	100.0%	564	100.0%	564	100%

E.3.2 Peak Service Delivery

Future baseline (CBTC) and “Super Model” operations were evaluated in terms of simulated peak service delivery at several key locations throughout the study area. Service delivery is measured in terms of trains passing in the peak 60 minutes during the morning and evening. Peak periods and service deliveries are only reported in this section if they fall completely within the 6 a.m. to 10 a.m. or 2 p.m. to 8 p.m. time periods.

As discussed in paragraph G.1.3.4, the same dwell times have been applied to both the wayside and CBTC simulation models. As all CBTC simulation models achieve higher scheduled and simulated service delivery than the wayside simulation model, however, dwell times at many locations will almost certainly be reduced. CBTC simulation results are therefore conservative at locations where dwell time is a known capacity constraint (e.g. Grand Central - 42 Street). In certain cases what was achieved is greater than the corresponding input due to variability in the model.

For the simulated maximum TPH at each location, refer to Table G.7-1 and Table G.7-2.

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E.3.2.1 Scheduled and Simulated (Achieved) Outputs: Nevins Street

Table E.3-2. Scheduled and Simulated Peak Service Delivery – Nevins Street

Morning Peak Service Delivery						
			② ③ Line		④ ⑤ Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”	CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	28	28	31	31
		Peak Hour	7:29 – 8:29	8:29 – 9:29	8:10 – 9:10	8:10 – 9:10
	Simulated	TPH	27	27	32	32
		Peak Hour	7:50 – 8:50	7:48 – 8:48	8:28 – 9:28	8:25 – 9:25
Southbound	Scheduled	TPH	26	26	31	31
		Peak Hour	6:54 – 7:54	6:54 – 7:54	7:21 – 8:21	7:21 – 8:21
	Simulated	TPH	27	27	30	30
		Peak Hour	7:19 – 8:19	7:19 – 8:19	7:15 – 8:15	7:15 – 8:15
Evening Peak Service Delivery						
			② ③ Line		④ ⑤ Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”	CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	28	28	31	31
		Peak Hour	17:23 – 18:23	17:23 – 18:23	17:09 – 18:09	17:09 – 18:09
	Simulated	TPH	27	26	32	32
		Peak Hour	16:30 – 17:30	16:22 – 17:22	17:08 – 18:08	17:08 – 18:08
Southbound	Scheduled	TPH	25	25	31	31
		Peak Hour	15:56 – 16:56	15:56 – 16:56	16:21 – 17:21	16:21 – 17:21
	Simulated	TPH	26	26	32	32
		Peak Hour	16:49 – 17:49	16:49 – 17:49	16:29 – 17:29	16:29 – 17:29

E.3.2.2 Scheduled and Simulated (Achieved) Outputs: Grand Central - 42 Street

The longest dwell time along the Lexington Avenue Line, 55 seconds, occurs during the p.m. peak period on the northbound express track at Grand Central - 42 Street. Additionally, as CBTC operation treats the lengthy interlocking north of the platform as one fixed block, simulated northbound service on the ④ Line and ⑤ Line is ultimately constrained at 29 TPH during this period in the Future Baseline CBTC model.

The interlocking north of Grand Central - 42 Street is subdivided in the “Super Model,” as discussed in paragraph E.2.1.4. As a result, the northbound express track experiences reduced congestion as trains take less time to clear the shorter subdivided interlockings. Northbound express track simulated capacity therefore increases from 29 TPH to 31 TPH in the “Super Model” with the Future Baseline operating plan.

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Table E.3-3. Scheduled and Simulated Peak Service Delivery – Grand Central-42 Street

Morning Peak Service Delivery						
			4 5 Line		6 Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”	CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	32	32	31	31
		Peak Hour	8:40 – 9:40	8:40 – 9:40	8:09 – 9:09	8:09 – 9:09
	Simulated	TPH	32	32	30	30
		Peak Hour	8:45 – 9:45	8:45 – 9:45	7:44 – 8:44	7:44 – 8:44
Southbound	Scheduled	TPH	31	31	30	30
		Peak Hour	7:03 – 8:03	7:03 – 8:03	7:17 – 8:17	7:17 – 8:17
	Simulated	TPH	31	31	30	30
		Peak Hour	7:09 – 8:09	7:09 – 8:09	7:12 – 8:12	7:12 – 8:12
Evening Peak Service Delivery						
			4 5 Line		6 Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”	CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	31	31	31	31
		Peak Hour	17:27 – 18:27	17:27 – 18:27	17:09 – 18:09	17:09 – 18:09
	Simulated	TPH	29	31	31	30
		Peak Hour	16:25 – 17:25	17:26 – 18:26	16:19 – 17:19	16:09 – 17:09
Southbound	Scheduled	TPH	31	31	30	30
		Peak Hour	16:03 – 17:03	16:03 – 17:03	15:39 – 16:39	15:39 – 16:39
	Simulated	TPH	32	32	31	31
		Peak Hour	16:09 – 17:09	16:09 – 17:09	15:37 – 16:37	15:37 – 16:37

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E.3.2.3 Scheduled and Simulated (Achieved) Outputs: 125 Street

Table E.3-4. Scheduled and Simulated Peak Service Delivery – 125 Street

Morning Peak Service Delivery						
			4 5 Line		6 Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”	CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	32	32	31	31
		Peak Hour	8:49 – 9:49	8:49 – 9:49	8:23 – 9:23	8:23 – 9:23
	Simulated	TPH	32	32	30	30
		Peak Hour	8:54 – 9:54	8:53 – 9:53	7:59 – 8:59	7:59 – 8:59
Southbound	Scheduled	TPH	31	31	30	30
		Peak Hour	6:54 – 7:54	6:54 – 7:54	6:59 – 7:59	6:59 – 7:59
	Simulated	TPH	31	31	30	30
		Peak Hour	6:59 – 7:59	6:59 – 7:59	6:56 – 7:56	6:56 – 7:56
Evening Peak Service Delivery						
			4 5 Line		6 Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”	CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	31	31	31	31
		Peak Hour	17:36 – 18:36	17:36 – 18:36	17:23 – 18:23	17:23 – 18:23
	Simulated	TPH	29	31	31	30
		Peak Hour	16:44 – 17:44	17:37 – 18:37	16:37 – 17:37	16:25 – 17:25
Southbound	Scheduled	TPH	31	31	30	30
		Peak Hour	15:54 – 16:54	15:54 – 16:54	15:21 – 16:21	15:21 – 16:21
	Simulated	TPH	32	32	31	31
		Peak Hour	16:00 – 17:00	16:00 – 17:00	15:21 – 16:21	15:21 – 16:21

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E.3.2.4 Scheduled and Simulated (Achieved) Outputs: Times Square - 42 Street

Table E.3-5. Scheduled and Simulated Peak Service Delivery – Times Square-42 Street

Morning Peak Service Delivery						
			① Line		② ③ Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”	CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	32	32	28	28
		Peak Hour	8:37 - 9:37	8:37 - 9:37	8:48 – 9:48	8:48 – 9:48
	Simulated	TPH	31	31	27	27
		Peak Hour	8:25 – 9:25	8:25 – 9:25	8:08 – 9:08	8:07 – 9:07
Southbound	Scheduled	TPH	31	31	26	26
		Peak Hour	8:00 – 9:00	8:00 – 9:00	6:36 – 7:36	6:36 – 7:36
	Simulated	TPH	32	32	27	27
		Peak Hour	8:13 – 9:13	8:13 – 9:13	7:01 – 8:01	7:01 – 8:01
Evening Peak Service Delivery						
			① Line		② ③ Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”	CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	31	31	28	28
		Peak Hour	17:14 – 18:14	17:14 – 18:14	17:42 – 18:42	17:42 – 18:42
	Simulated	TPH	31	31	27	26
		Peak Hour	18:14 – 19:14	18:14 – 19:14	16:50 – 17:50	16:42 – 17:42
Southbound	Scheduled	TPH	31	31	25	25
		Peak Hour	17:36 – 18:36	17:36 – 18:36	15:38 – 16:38	15:38 – 16:38
	Simulated	TPH	31	31	26	26
		Peak Hour	17:15 – 18:15	17:15 – 18:15	16:30 – 17:30	16:30 – 17:30

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E.3.2.5 Scheduled and Simulated (Achieved) Outputs: 96 Street

Table E.3-6. Scheduled and Simulated Peak Service Delivery – 96 Street

Morning Peak Service Delivery						
			① Line		② ③ Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”	CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	32	32	27	27
		Peak Hour	8:48 – 9:48	8:48 – 9:48	8:06 – 9:06	8:06 – 9:06
	Simulated	TPH	31	31	27	27
		Peak Hour	8:36 – 9:36	8:36 – 9:36	8:21 – 9:21	8:13 – 9:13
Southbound	Scheduled	TPH	31	31	26	26
		Peak Hour	7:59 – 8:59	7:59 – 8:59	6:30 – 7:30	6:30 – 7:30
	Simulated	TPH	32	32	27	27
		Peak Hour	8:03 – 9:03	8:03 – 9:03	6:54 – 7:54	6:54 – 7:54
Evening Peak Service Delivery						
			① Line		② ③ Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”	CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	31	31	28	28
		Peak Hour	17:25 – 18:25	17:25 – 18:25	17:59 – 18:59	17:59 – 18:59
	Simulated	TPH	31	31	27	26
		Peak Hour	18:25 – 19:25	18:25 – 19:25	16:56 – 17:56	16:48 – 17:48
Southbound	Scheduled	TPH	31	31	25	25
		Peak Hour	17:25 – 18:25	17:25 – 18:25	15:32 – 16:32	15:32 – 16:32
	Simulated	TPH	31	31	26	26
		Peak Hour	17:02 – 18:02	17:02 – 18:02	16:24 – 17:24	16:24 – 17:24

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E.3.2.6 Scheduled and Simulated (Achieved) Outputs: East 180 Street

Table E.3-7. Scheduled and Simulated Peak Service Delivery – East 180 Street

Morning Peak Service Delivery						
			② Line		⑤ Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”	CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	13	13	11	11
		Peak Hour	8:25 – 9:25	8:25 – 9:25	8:47 – 9:47	8:47 – 9:47
	Simulated	TPH	14	14	11	11
		Peak Hour	8:47 – 9:47	8:48 – 9:48	8:27 – 9:27	8:26 – 9:26
Southbound	Scheduled	TPH	14	14	11	11
		Peak Hour	6:04 – 7:04	6:04 – 7:04	6:26 – 7:26	6:26 – 7:26
	Simulated	TPH	14	14	11	11
		Peak Hour	6:04 – 7:04	6:04 – 7:04	6:25 – 7:25	6:25 – 7:25
Evening Peak Service Delivery						
			② Line		⑤ Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”	CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	14	14	11	11
		Peak Hour	18:13 – 19:13	18:13 – 19:13	18:18 – 19:18	18:18 – 19:18
	Simulated	TPH	14	14	11	11
		Peak Hour	17:29 – 18:29	17:08 – 18:08	18:20 – 19:20	17:47 – 18:47
Southbound	Scheduled	TPH	13	13	11	11
		Peak Hour	15:02 – 16:02	15:02 – 16:02	15:37 – 16:37	15:37 – 16:37
	Simulated	TPH	14	14	11	11
		Peak Hour	15:15 – 16:15	15:15 – 16:15	15:37 – 16:37	15:37 – 16:37

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E.3.2.7 Scheduled and Simulated (Achieved) Outputs: 231 Street

Table E.3-8. Scheduled and Simulated Peak Service Delivery – 231 Street

Morning Peak Service Delivery				
			① Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	27	27
		Peak Hour	8:59 – 9:59	8:59 – 9:59
	Simulated	TPH	26	26
		Peak Hour	8:42 – 9:42	8:42 – 9:42
Southbound	Scheduled	TPH	25	25
		Peak Hour	6:42 – 7:42	6:42 – 7:42
	Simulated	TPH	26	26
		Peak Hour	7:19 – 8:19	7:19 – 8:19
Evening Peak Service Delivery				
			① Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	27	27
		Peak Hour	17:47 – 18:47	17:47 – 18:47
	Simulated	TPH	27	27
		Peak Hour	18:03 – 19:03	18:03 – 19:03
Southbound	Scheduled	TPH	26	26
		Peak Hour	16:24 – 17:24	16:24 – 17:24
	Simulated	TPH	26	26
		Peak Hour	16:25 – 17:25	16:25 – 17:25

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E.3.2.8 Scheduled and Simulated (Achieved) Outputs: 145 Street

Table E.3-9. Scheduled and Simulated Peak Service Delivery – 145 Street

Morning Peak Service Delivery				
			3 Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	14	14
		Peak Hour	8:17 – 9:17	8:17 – 9:17
	Simulated	TPH	14	14
		Peak Hour	8:37 – 9:37	8:23 – 9:23
Southbound	Scheduled	TPH	13	13
		Peak Hour	6:17 – 7:17	6:17 – 7:17
	Simulated	TPH	14	14
		Peak Hour	6:37 – 7:37	6:37 – 7:37
Evening Peak Service Delivery				
			3 Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	14	14
		Peak Hour	17:58 – 18:58	17:58 – 18:58
	Simulated	TPH	14	14
		Peak Hour	17:07 – 18:07	18:12 – 19:12
Southbound	Scheduled	TPH	13	13
		Peak Hour	16:29 – 17:29	16:29 – 17:29
	Simulated	TPH	13	13
		Peak Hour	16:13 – 17:13	16:13 – 17:13

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E.3.2.9 Scheduled and Simulated (Achieved) Outputs: Burnside Avenue

Table E.3-10. Scheduled and Simulated Peak Service Delivery – Burnside Avenue

Morning Peak Service Delivery				
			4 Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	22	22
		Peak Hour	8:51 – 9:51	8:51 – 9:51
	Simulated	TPH	21	21
		Peak Hour	8:48 – 9:48	8:46 – 9:46
Southbound	Scheduled	TPH	21	21
		Peak Hour	6:40 – 7:40	6:40 – 7:40
	Simulated	TPH	21	21
		Peak Hour	6:38 – 7:38	6:38 – 7:38
Evening Peak Service Delivery				
			4 Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	22	22
		Peak Hour	16:43 – 17:43	16:43 – 17:43
	Simulated	TPH	22	22
		Peak Hour	16:46 – 17:46	16:45 – 17:45
Southbound	Scheduled	TPH	22	22
		Peak Hour	14:53 - 15:53	14:53 - 15:53
	Simulated	TPH	22	22
		Peak Hour	14:53 – 15:53	14:53 – 15:53

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E.3.2.10 Scheduled and Simulated (Achieved) Outputs: Baychester Avenue

Table E.3-11. Scheduled and Simulated Peak Service Delivery – Baychester Avenue

Morning Peak Service Delivery				
			5 Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	11	11
		Peak Hour	8:56 – 9:56	8:56 – 9:56
	Simulated	TPH	11	11
		Peak Hour	8:35 – 9:35	8:34 – 9:34
Southbound	Scheduled	TPH	8	8
		Peak Hour	6:11 – 7:11	6:11 – 7:11
	Simulated	TPH	8	8
		Peak Hour	6:10 – 7:10	6:10 – 7:10
Evening Peak Service Delivery				
			5 Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	10	10
		Peak Hour	18:56 – 19:56	18:56 – 19:56
	Simulated	TPH	10	10
		Peak Hour	18:55 – 19:55	18:55 – 19:55
Southbound	Scheduled	TPH	11	11
		Peak Hour	15:28 – 16:28	15:28 – 16:28
	Simulated	TPH	11	11
		Peak Hour	15:28 – 16:28	15:28 – 16:28

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E.3.2.11 Scheduled and Simulated (Achieved) Outputs: Hunts Point Avenue

Table E.3-12. Scheduled and Simulated Peak Service Delivery – Hunts Point Avenue

Morning Peak Service Delivery				
			6 Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	31	31
		Peak Hour	8:35 – 9:35	8:35 – 9:35
	Simulated	TPH	30	30
		Peak Hour	8:10 – 9:10	8:10 – 9:10
Southbound	Scheduled	TPH	30	30
		Peak Hour	6:46 – 7:46	6:46 – 7:46
	Simulated	TPH	30	30
		Peak Hour	6:46 – 7:46	6:46 – 7:46
Evening Peak Service Delivery				
			6 Line	
			CBTC Future Baseline	CBTC Future Baseline “Super Model”
Northbound	Scheduled	TPH	31	31
		Peak Hour	17:31 – 18:31	17:31 – 18:31
	Simulated	TPH	31	30
		Peak Hour	16:47 – 17:47	16:34 – 17:34
Southbound	Scheduled	TPH	30	30
		Peak Hour	15:09 – 16:09	15:09 – 16:09
	Simulated	TPH	31	31
		Peak Hour	15:10 – 16:10	15:10 – 16:10

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E.4 “Super Model” (CBTC) Results – Hybrid Operating Plan

“Super Model” simulation results under the Hybrid operating plan include end terminal on-time performance and peak service delivery (simulated versus scheduled). Apart from the infrastructure improvements and operating plan differences discussed in Section E.2, all simulation inputs and parameters are identical to those of the CBTC Future Baseline model.

E.4.1 On-Time Performance

Table E.4-1 displays “Super Model” (CBTC) on-time performance for each line under the Hybrid operating plan for three different end terminal lateness thresholds. Using a five-minute lateness threshold, the overall simulation shows a 95.8 percent OTP.

Table E.4-1. Simulated Terminal On-Time Performance by Line – Hybrid Operating Plan

Lateness Threshold	00:00:00		00:05:00		00:10:00		All Stops	
Subway Line	Trips	Pct (%)	Trips	Pct (%)	Trips	Pct (%)	Trips	Pct (%)
1	155	24.1%	597	93.0%	641	99.8%	642	100%
2 8	119	23.5%	446	88.1%	502	99.2%	506	100%
3	238	75.3%	313	99.1%	316	100%	316	100%
4	298	72.7%	406	99.0%	409	100%	410	100%
5	187	63.2%	292	98.6%	296	100%	296	100%
6	443	68.8%	643	99.8%	644	100%	644	100%
Combined	1440	51.2%	2697	95.8%	2808	99.8%	2814	100%
Lateness Threshold	00:00:00		00:05:00		00:10:00		All Stops	
Subway Line	Trips	Pct (%)	Trips	Pct (%)	Trips	Pct (%)	Trips	Pct (%)
S	282	50.0%	564	100.0%	564	100.0%	564	100%

E.4.2 Peak Service Delivery

Future baseline (CBTC) and “Super Model” operations were evaluated in terms of simulated peak service delivery at several key locations throughout the study area. Service delivery is measured in terms of trains passing in the peak 60 minutes during the morning and evening. Peak periods and service deliveries are only reported in this section if they fall completely within the 6 a.m. to 10 a.m. or 2 p.m., to 8 p.m. time periods.

The future baseline plan developed by the STV Team based on NYCT input recognizes Nostrand Junction as one of the critical A-Division bottlenecks. Because of the track layout, the total of 2 Line, 3 Line, and 5 Line service to Flatbush Avenue – Brooklyn College and on the local track to Crown Heights - Utica Avenue cannot exceed 30 TPH. The operating plan calls for the following train volumes in the southbound morning peak with similar train volumes northbound in the evening peak:

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Table E.4-2. Peak Hour Volumes: Hybrid Operating Plan

Subway Line	Trains per Hour	Northern Terminus	Southern Terminus
1	30	Van Cortlandt Park - 242 St (26) 137 Street – City College (4)	South Ferry
2	13	Wakefield - 241 Street	Flatbush Avenue - Brooklyn College
3	13	Harlem - 148 St	Flatbush Avenue - Brooklyn College
4	22	Woodlawn	Crown Heights - Utica Avenue
5	8	Eastchester - Dyre Avenue (5) Nereid Avenue (3)	New Lots Avenue
6	30	Pelham Bay Park (15) Parkchester (15)	Brooklyn Bridge – City Hall

This results in the combined 2 and 3 Lines at 26 TPH, the combined 4 and 5 Lines at 30 TPH and the 1 and 6 Line each at 30 TPH in the future baseline (CBTC) plan. The future baseline plan schedules the 30 TPH volume for at least two hours in the peak: approximately 7 a.m. to 9 a.m. and 4:30 a.m. to 6:30 p.m. The off-peak A-Division operating plans are based on the same RTIF source files as the baseline calibration simulation, as shown in Table F.1-4. Note that the peak train volumes shown in the table above are achieved concurrently; localized peaks are higher. This is especially true for the 5 Line, which splits into two branches in the Bronx. The localized peak train volumes are shown in Table E.4-4 through Table E.4-14.

The future modified hybrid plan developed by the STV Team based on NYCT input is not limited by capacity constraints at Nostrand Junction. This plan calls for the following train volumes in the southbound morning peak with similar train volumes northbound in the evening peak:

Table E.4-3. Peak Hour Volumes: Future (CBTC) Operating Plan

Subway Line	Trains per Hour	Northern Terminus	Southern Terminus
1	30	Van Cortlandt Park - 242 St (26) 137 Street – City College (4)	South Ferry
2	12	Wakefield - 241 Street	Flatbush Avenue - Brooklyn College
3	12	Harlem - 148 St	Flatbush Avenue - Brooklyn College
4	19	Woodlawn	Crown Heights - Utica Avenue
5	11	Eastchester - Dyre Avenue (7) Nereid Avenue (4)	New Lots Avenue
6	30	Pelham Bay Park (15) Parkchester (15)	Brooklyn Bridge – City Hall
8	6	Wakefield - 241 Street	New Lots Avenue

The future modified hybrid plan schedules these train volumes for at least two hours in the peak – approximately 7 a.m. to 9 a.m. and 4:30 a.m. to 6:30 p.m. The future modified hybrid plan schedules a full 30 TPH on both the West Side and East Side express services in Manhattan, about 4 TPH higher on the West Side Lines than in the future baseline plan that is constrained by

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Nostrand Junction. The off-peak A-Division operating plans are based on the same RTIF source files as the baseline calibration simulation, as shown in Table F.1-4. Note that the peak train volumes shown in the table above are achieved concurrently; localized peaks are higher. This is especially true for the 5 Line, which splits into two branches in the Bronx. The localized peak train volumes are shown in Table E.4-4 through Table E.4-14.

Given the introduction of the 8 Line service in the Hybrid Operating Plan, scheduled and simulated peak service delivery values are significantly higher for the 2 Line, 3 Line, and 8 Line when compared to the Future Baseline operating plan. As discussed in paragraph E.2.2.2, the Hybrid operating plan delivers 30 TPH across all three services while the Future Baseline operating plan delivers 26 TPH across the 2 Line and 3 Line.

As discussed in paragraph G.1.3.4, the same dwell times have been applied to both the wayside and CBTC simulation models. As all CBTC simulation models achieve higher scheduled and simulated service delivery than the wayside simulation model, however, dwell times at many locations will almost certainly be reduced. CBTC simulation results are therefore conservative at locations where dwell time is a known capacity constraint (e.g. Grand Central - 42 Street).

E.4.2.1 Nevins Street

Table E.4-4. Scheduled and Simulated Peak Service Delivery – Nevins Street

Morning Peak Service Delivery						
			2 3 8 Line		4 5 Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan	CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	28	31	31	31
		Peak Hour	7:29 – 8:29	7:52 – 8:52	8:10 – 9:10	8:01 – 9:01
	Simulated	TPH	27	32	32	30
		Peak Hour	7:50 – 8:50	8:15 – 9:15	8:28 – 9:28	7:56 – 8:56
Southbound	Scheduled	TPH	26	31	31	31
		Peak Hour	6:54 – 7:54	7:05 – 8:05	7:21 – 8:21	7:05 – 8:05
	Simulated	TPH	27	32	30	30
		Peak Hour	7:19 – 8:19	7:25 – 8:25	7:15 – 8:15	7:08 – 8:08
Evening Peak Service Delivery						
			2 3 8 Line		4 5 Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan	CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	28	31	31	31
		Peak Hour	17:23 – 18:23	17:29 – 18:29	17:09 – 18:09	17:55 – 18:55
	Simulated	TPH	27	31	32	31
		Peak Hour	16:30 – 17:30	17:21 – 18:21	17:08 – 18:08	17:21 – 18:21
Southbound	Scheduled	TPH	25	31	31	31
		Peak Hour	15:56 – 16:56	17:06 – 18:06	16:21 – 17:21	16:45 – 17:45
	Simulated	TPH	26	31	32	31
		Peak Hour	16:49 – 17:49	16:34 – 17:34	16:29 – 17:29	16:45 – 17:45

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E.4.2.2 Grand Central - 42 Street

The longest dwell time along the Lexington Avenue Line, 55 seconds, occurs during the p.m. peak period on the northbound express track at Grand Central - 42 Street. Additionally, as CBTC operation treats the lengthy interlocking north of the platform as one fixed block, simulated northbound service on the 4 Line and 5 Line is ultimately constrained at 29 TPH in the Future Baseline CBTC model during this period.

The interlocking north of Grand Central - 42 Street is subdivided in the “Super Model” as discussed in paragraph E.2.1.4. As a result, the northbound express track experiences reduced congestion as trains take less time to clear the shorter subdivided interlockings. Northbound express track simulated capacity therefore increases from 29 TPH to 30 TPH in the “Super Model” with the Future Baseline operating plan.

Table E.4-5. Scheduled and Simulated Peak Service Delivery – Grand Central-42 Street

Morning Peak Service Delivery						
			4 5 Line		6 Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan	CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	32	31	31	31
		Peak Hour	8:40 – 9:40	8:18 – 9:18	8:09 – 9:09	8:09 – 9:09
	Simulated	TPH	32	30	30	30
		Peak Hour	8:45 – 9:45	8:13 – 9:13	7:44 – 8:44	7:44 – 8:44
Southbound	Scheduled	TPH	31	31	30	30
		Peak Hour	7:03 – 8:03	6:48 – 7:48	7:17 – 8:17	7:17 – 8:17
	Simulated	TPH	31	30	30	30
		Peak Hour	7:09 – 8:09	6:50 – 7:50	7:12 – 8:12	7:12 – 8:12
Evening Peak Service Delivery						
			4 5 Line		6 Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan	CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	31	32	31	31
		Peak Hour	17:27 – 18:27	17:55 – 18:55	17:09 – 18:09	17:09 – 18:09
	Simulated	TPH	29	30	31	30
		Peak Hour	16:25 – 17:25	17:37 – 18:37	16:19 – 17:19	16:09 – 17:09
Southbound	Scheduled	TPH	31	31	30	30
		Peak Hour	16:03 – 17:03	16:27 – 17:27	15:39 – 16:39	15:39 – 16:39
	Simulated	TPH	32	31	31	31
		Peak Hour	16:09 – 17:09	16:27 – 17:27	15:37 – 16:37	15:37 – 16:37

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E.4.2.3 125 Street

Table E.4-6. Scheduled and Simulated Peak Service Delivery – 125 Street

Morning Peak Service Delivery						
			4 5 Line		6 Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan	CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	32	31	31	31
		Peak Hour	8:49 – 9:49	8:27 – 9:27	8:23 – 9:23	8:23 – 9:23
	Simulated	TPH	32	30	30	30
		Peak Hour	8:54 – 9:54	8:22 – 9:22	7:59 – 8:59	7:59 – 8:59
Southbound	Scheduled	TPH	31	31	30	30
		Peak Hour	6:54 – 7:54	6:39 – 7:39	6:59 – 7:59	6:59 – 7:59
	Simulated	TPH	31	31	30	30
		Peak Hour	6:59 – 7:59	6:43 – 7:43	6:56 – 7:56	6:56 – 7:56
Evening Peak Service Delivery						
			4 5 Line		6 Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan	CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	31	32	31	31
		Peak Hour	17:36 – 18:36	18:04 – 19:04	17:23 – 18:23	17:23 – 18:23
	Simulated	TPH	29	30	31	30
		Peak Hour	16:44 – 17:44	17:46 – 18:46	16:37 – 17:37	16:35 – 17:25
Southbound	Scheduled	TPH	31	31	30	30
		Peak Hour	15:54 – 16:54	16:18 – 17:18	15:21 – 16:21	15:21 – 16:21
	Simulated	TPH	32	31	31	31
		Peak Hour	16:00 – 17:00	16:18 – 17:18	15:21 – 16:21	15:21 – 16:21

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E.4.2.4 Times Square - 42 Street

Table E.4-7. Scheduled and Simulated Peak Service Delivery – Times Square-42 Street

Morning Peak Service Delivery						
			① Line		② ③ ⑧ Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan	CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	32	32	28	32
		Peak Hour	8:37 - 9:37	8:37 - 9:37	8:48 – 9:48	8:47 – 9:47
	Simulated	TPH	31	31	27	32
		Peak Hour	8:25 – 9:25	8:25 – 9:25	8:08 – 9:08	8:34 – 9:34
Southbound	Scheduled	TPH	31	31	26	31
		Peak Hour	8:00 – 9:00	8:00 – 9:00	6:36 – 7:36	6:46 – 7:46
	Simulated	TPH	32	32	27	32
		Peak Hour	8:13 – 9:13	8:13 – 9:13	7:01 – 8:01	7:07 – 8:07
Evening Peak Service Delivery						
			① Line		② ③ ⑧ Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan	CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	31	31	28	32
		Peak Hour	17:14 – 18:14	17:14 – 18:14	17:42 – 18:42	18:37 – 19:37
	Simulated	TPH	31	31	27	31
		Peak Hour	18:14 – 19:14	18:14 – 19:14	16:50 – 17:50	17:51 – 18:51
Southbound	Scheduled	TPH	31	31	25	30
		Peak Hour	17:36 – 18:36	17:36 – 18:36	15:38 – 16:38	16:10 – 17:10
	Simulated	TPH	31	31	26	31
		Peak Hour	17:15 – 18:15	17:15 – 18:15	16:30 – 17:30	16:16 – 17:16

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E.4.2.5 96 Street

Table E.4-8. Scheduled and Simulated Peak Service Delivery – 96 Street

Morning Peak Service Delivery						
			① Line		② ③ ⑧ Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan	CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	32	32	27	32
		Peak Hour	8:48 – 9:48	8:48 – 9:48	8:06 – 9:06	8:52 – 9:52
	Simulated	TPH	31	31	27	32
		Peak Hour	8:36 – 9:36	8:36 – 9:36	8:21 – 9:21	8:40 – 9:40
Southbound	Scheduled	TPH	31	31	26	31
		Peak Hour	7:59 – 8:59	7:59 – 8:59	6:30 – 7:30	6:40 – 7:40
	Simulated	TPH	32	32	27	32
		Peak Hour	8:03 – 9:03	8:03 – 9:03	6:54 – 7:54	7:01 – 8:01
Evening Peak Service Delivery						
			① Line		② ③ ⑧ Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan	CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	31	31	28	28
		Peak Hour	17:25 – 18:25	17:25 – 18:25	17:59 – 18:59	17:59 – 18:59
	Simulated	TPH	31	31	27	27
		Peak Hour	18:25 – 19:25	18:25 – 19:25	16:56 – 17:56	16:56 – 17:56
Southbound	Scheduled	TPH	31	31	25	25
		Peak Hour	17:25 – 18:25	17:25 – 18:25	15:32 – 16:32	15:32 – 16:32
	Simulated	TPH	31	31	26	26
		Peak Hour	17:02 – 18:02	17:02 – 18:02	16:24 – 17:24	16:24 – 17:24

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E.4.2.6 East 180 Street

Table E.4-9. Scheduled and Simulated Peak Service Delivery – East 180 Street

Morning Peak Service Delivery						
			2 8 Line		5 Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan	CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	13	19	11	11
		Peak Hour	8:25 – 9:25	8:43 – 9:43	8:47 – 9:47	8:48 – 9:48
	Simulated	TPH	14	19	11	10
		Peak Hour	8:47 – 9:47	8:58 – 9:58	8:27 – 9:27	8:40 – 9:40
Southbound	Scheduled	TPH	14	19	11	11
		Peak Hour	6:04 – 7:04	6:15 – 7:15	6:26 – 7:26	6:26 – 7:26
	Simulated	TPH	14	20	11	11
		Peak Hour	6:04 – 7:04	6:35 – 7:35	6:25 – 7:25	6:27 – 7:27
Evening Peak Service Delivery						
			2 8 Line		5 Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan	CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	14	18	11	11
		Peak Hour	18:13 – 19:13	17:52 – 18:52	18:18 – 19:18	17:49 – 18:49
	Simulated	TPH	14	19	11	11
		Peak Hour	17:29 – 18:29	18:11 – 19:11	18:20 – 19:20	18:02 – 19:02
Southbound	Scheduled	TPH	13	18	11	11
		Peak Hour	15:02 – 16:02	15:32 – 16:32	15:37 – 16:37	15:37 – 16:37
	Simulated	TPH	14	19	11	11
		Peak Hour	15:15 – 16:15	15:39 – 16:39	15:37 – 16:37	15:37 – 16:37

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E.4.2.7 231 Street

Table E.4-10. Scheduled and Simulated Peak Service Delivery – 231 Street

Morning Peak Service Delivery				
			① Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	27	27
		Peak Hour	8:59 – 9:59	8:59 – 9:59
	Simulated	TPH	26	26
		Peak Hour	8:42 – 9:42	8:42 – 9:42
Southbound	Scheduled	TPH	25	25
		Peak Hour	6:42 – 7:42	6:42 – 7:42
	Simulated	TPH	26	26
		Peak Hour	7:19 – 8:19	7:19 – 8:19
Evening Peak Service Delivery				
			① Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	27	27
		Peak Hour	17:47 – 18:47	17:47 – 18:47
	Simulated	TPH	27	27
		Peak Hour	18:03 – 19:03	18:03 – 19:03
Southbound	Scheduled	TPH	26	26
		Peak Hour	16:24 – 17:24	16:24 – 17:24
	Simulated	TPH	26	26
		Peak Hour	16:25 – 17:25	16:25 – 17:25

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E.4.2.8 145 Street

Table E.4-11. Scheduled and Simulated Peak Service Delivery – 145 Street

Morning Peak Service Delivery				
			3 Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	14	13
		Peak Hour	8:17 – 9:17	7:53 – 8:53
	Simulated	TPH	14	13
		Peak Hour	8:37 – 9:37	8:24 – 9:24
Southbound	Scheduled	TPH	13	13
		Peak Hour	6:17 – 7:17	6:05 – 7:05
	Simulated	TPH	14	13
		Peak Hour	6:37 – 7:37	6:04 – 7:04
Evening Peak Service Delivery				
			3 Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	14	13
		Peak Hour	17:58 – 18:58	18:03 – 19:03
	Simulated	TPH	14	13
		Peak Hour	17:07 – 18:07	18:00 – 19:00
Southbound	Scheduled	TPH	13	12
		Peak Hour	16:29 – 17:29	15:55 – 16:55
	Simulated	TPH	13	13
		Peak Hour	16:13 – 17:13	16:05 – 17:05

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E.4.2.9 Burnside Avenue

Table E.4-12. Scheduled and Simulated Peak Service Delivery – Burnside Avenue

Morning Peak Service Delivery				
			4 Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	22	21
		Peak Hour	8:51 – 9:51	8:22 – 9:22
	Simulated	TPH	21	21
		Peak Hour	8:48 – 9:48	8:35 – 9:35
Southbound	Scheduled	TPH	21	21
		Peak Hour	6:40 – 7:40	6:27 – 7:27
	Simulated	TPH	21	21
		Peak Hour	6:38 – 7:38	6:26 – 7:26
Evening Peak Service Delivery				
			4 Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	22	21
		Peak Hour	16:43 – 17:43	18:13 – 19:13
	Simulated	TPH	22	21
		Peak Hour	16:46 – 17:46	18:12 – 19:12
Southbound	Scheduled	TPH	22	21
		Peak Hour	14:53 - 15:53	16:05 – 17:05
	Simulated	TPH	22	21
		Peak Hour	14:53 – 15:53	16:04 – 17:04

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E.4.2.10 Baychester Avenue

Table E.4-13. Scheduled and Simulated Peak Service Delivery – Baychester Avenue

Morning Peak Service Delivery				
			5 Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	11	11
		Peak Hour	8:56 – 9:56	8:57 – 9:57
	Simulated	TPH	11	10
		Peak Hour	8:35 – 9:35	8:49 – 9:49
Southbound	Scheduled	TPH	8	8
		Peak Hour	6:11 – 7:11	6:11 – 7:11
	Simulated	TPH	8	8
		Peak Hour	6:10 – 7:10	6:10 – 7:10
Evening Peak Service Delivery				
			5 Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	10	10
		Peak Hour	18:56 – 19:56	18:56 – 19:56
	Simulated	TPH	10	10
		Peak Hour	18:55 – 19:55	18:57 – 19:57
Southbound	Scheduled	TPH	11	11
		Peak Hour	15:28 – 16:28	15:28 – 16:28
	Simulated	TPH	11	11
		Peak Hour	15:28 – 16:28	15:28 – 16:28

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E.4.2.11 Hunts Point Avenue

Table E.4-14. Scheduled and Simulated Peak Service Delivery – Hunts Point Avenue

Morning Peak Service Delivery				
			6 Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	31	31
		Peak Hour	8:35 – 9:35	8:35 – 9:35
	Simulated	TPH	30	30
		Peak Hour	8:10 – 9:10	8:10 – 9:10
Southbound	Scheduled	TPH	30	30
		Peak Hour	6:46 – 7:46	6:46 – 7:46
	Simulated	TPH	30	30
		Peak Hour	6:46 – 7:46	6:46 – 7:46
Evening Peak Service Delivery				
			6 Line	
			CBTC Future Baseline	CBTC “Super Model” – Hybrid Op Plan
Northbound	Scheduled	TPH	31	31
		Peak Hour	17:31 – 18:31	17:31 – 18:31
	Simulated	TPH	31	30
		Peak Hour	16:47 – 17:47	16:34 – 17:34
Southbound	Scheduled	TPH	30	30
		Peak Hour	15:09 – 16:09	15:09 – 16:09
	Simulated	TPH	31	31
		Peak Hour	15:10 – 16:10	15:10 – 16:10

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E.5 Model Comparison

E.5.1 On-Time Performance Comparison

Table E.5-1 compares on-time performance between the Existing (wayside) Baseline, CBTC Future Baseline, and “Super Models” under both Future Baseline and Hybrid operating plans.

The on-time performance of the 2 Line and 8 Line decreases in the “Super Model” with the Hybrid operating plan as a result, but with no cascading effects on the 3 Line, 4 Line, and 5 Line. This can be attributed partly to congestion at Wakefield - 241 St, which turns 18 TPH for the 2 Line and 8 Line under the Hybrid operating plan but only 13 TPH under the Future Baseline operating plan.

Poorer on-time performance can also be attributed partly to congestion at New Lots Avenue, which turns 16 TPH for the 5 Line and 8 Line under the Hybrid operating plan but only 13 TPH for the 3 Line under the Future Baseline operating plan. As discussed in paragraph C.3.6.3, New Lots Avenue with crossover improvements has a practical CBTC capacity of 20 revenue turns plus 6 yard put-ins per hour.

6 Line on-time performance increases significantly under both “Super Models” as a result of reduced congestion facilitated by the proposed crossovers south of Parkchester.

Table E.5-1. Comparison of Simulated Full Day On-Time Performance by Line

Subway Line	Wayside Simulated	Phases I-IV CBTC Base Op Plan Simulated	Super Model CBTC Base Op Plan Simulated	Super Model CBTC Hybrid Op Plan Simulated
1	92.4%	93.0%	93.0%	93.0%
2 8*	81.2%	93.7%	94.5%	88.1%
3	93.1%	90.8%	93.8%	99.1%
4	91.6%	98.4%	98.9%	99.0%
5	93.0%	94.3%	95.3%	98.6%
6	90.6%	97.2%	99.8%	99.8%
Average	90.5%	94.8%	96.1%	95.8%
Subway Line	Wayside Simulated	Phases I-IV CBTC Base Op Plan Simulated	Super Model CBTC Base Op Plan Simulated	Super Model CBTC Hybrid Op Plan Simulated
S	100.0%	100.0%	100.0%	100.0%

Note: Super Model Hybrid Plan 8 Line results are included with the 2 Line

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E.5.2 Peak Service Delivery Comparison

Table E.5-2 compares both peak service delivery and on-time performance between the CBTC Future Baseline and both “Super Models” under the Future Baseline and Hybrid operating plans.

Table E.5-2. Comparison of Simulated Terminal On-Time Performance and Peak Service Delivery by Line

	Phases I-IV CBTC Base Operating Plan Simulated		Super Model CBTC Base Operating Plan Simulated		Super Model CBTC Hybrid Operating Plan Simulated	
Subway Line	Scheduled TPH	OTP	Scheduled TPH	OTP	Scheduled TPH	OTP
1	30	93.0%	30	93.0%	30	93.0%
2 8*	13	93.7%	13	94.5%	12	88.1%
3	13	90.8%	13	93.8%	12	99.1%
4	23	98.4%	23	98.9%	20	99.0%
5	7	94.3%	7	95.3%	10	98.6%
6	30	97.2%	30	99.8%	30	99.8%
Combined	116	94.8%	116	96.1%	120	95.8%
	Phases I-IV CBTC Base Operating Plan Simulated		Super Model CBTC Base Operating Plan Simulated		Super Model CBTC Hybrid Operating Plan Simulated	
Subway Line	Scheduled TPH	OTP	Scheduled TPH	OTP	Scheduled TPH	OTP
S	20	100.0%	20	100.0%	20	100.0%

Note: Super Model Hybrid Plan 8 Line results are included with the 2 Line

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IRT CAPACITY STUDY

1 2 3 4 5 6 S LINES

F - APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM



Prepared for:



by:
STV
July 2020

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APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

F.0 Revision History – Not Applicable

F.1 Input Data, Assumptions and Methodology

F.1.1 Rolling Stock

The relevant A-Division fleets include the R62, R62A, R142, and R142A for existing operations. In addition, the R188 fleet, presently supporting communications-based train control (CBTC) on the 7 Flushing Line (not part of the scope of work) is relevant for future A-Division CBTC modeling. The R62 and R62A fleets are considered as a single model for simulation modeling purposes. Similarly, the R142 and R142A are considered as a single model. Wayside (“trip stop”) and CBTC modes are addressed separately for the R142/R142A and R188 models by ensuring both tractive effort curves are available per vehicle type. The older R62/R62A models will be retired prior to the implementation of CBTC on the full A-Division and therefore have only a wayside (“trip stop”) performance mode.

F.1.1.1 Physical and Performance Characteristics

Table F.1-1 summarizes the A-Division rolling stock to be reflected in the simulations. The referenced 50 MPH maximum speed is normally attainable only with the future CBTC tractive effort enabled. Additional figures in this section show the per-car tractive effort/propulsion current (AW2) and braking effort curves (AW3). The braking effort curves show total per-car braking effort, along with a sub-division separating electrical (dynamic/regenerative) braking from friction braking. In general, most of the braking effort of these vehicle types is achieved through dynamic/regenerative braking. For all vehicle type the mechanical resistance was modeled using Davis Coefficients and train resistance formula:

$$TR = 1.3W + 29n + 0.045WV + [0.0024 + 0.00034(Q - 1)]AV^2$$

where:

TR = Total train resistance in pounds force

W = Total train weight in tons

n = number of axles in the train

V = Train speed in miles per hour

A = Frontal area in square feet

Q = Number of cars in the train

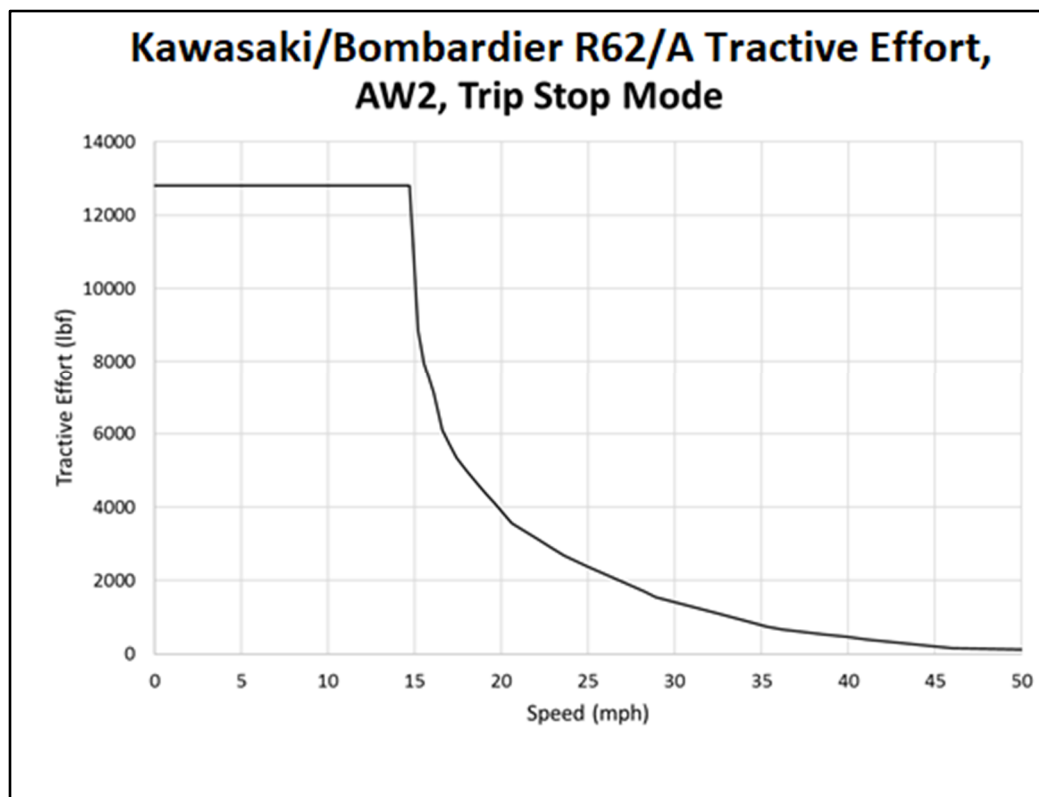
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Table F.1-1. A-Division Rolling Stock Characteristics for Simulation

Model	Kawasaki R62/ Bombardier R62A	Bombardier/ Kawasaki R142/R142A	Kawasaki R188
Length (feet)	51.05	51.3	51
Weight (pounds) – AW0	74,593	71,964	70,527
Passenger Capacity (Seated)	44	37	37
Passenger Capacity (Total) – AW3	182	182	183
Number of Axles	4	4	4
Maximum Operating Speed (mph)	50	50	50
Nominal Acceleration (mph/s)	2.5	2.5	2.5
Service Brake Rate (mph/s)	3.0	3.0	3.0
Rotational Mass (%)	8.0	8.0	8.0
Frontal Area (ft ²)	100	102	102

Note that the Nominal Acceleration value is not indicative of overall time to attain maximum speed. As discussed in Section F.2, the performance of the R62/R62A is inferior to that of the later generation A-Division vehicles when comparing “trip stop” (wayside signaling) performance. Similarly, the referenced Service Brake Rate is not actually experienced in simulation. As discussed in Section F.2, all A-Division vehicle types were modeled with somewhat gentler deceleration as a result of the calibration effort to mimic actual field performance.

Figure F.1-1. TE for R62/A Model at AW2, Trip Stop Mode



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Figure F.1-2: TE/Current for R142/A Model at AW2, Trip Stop Mode

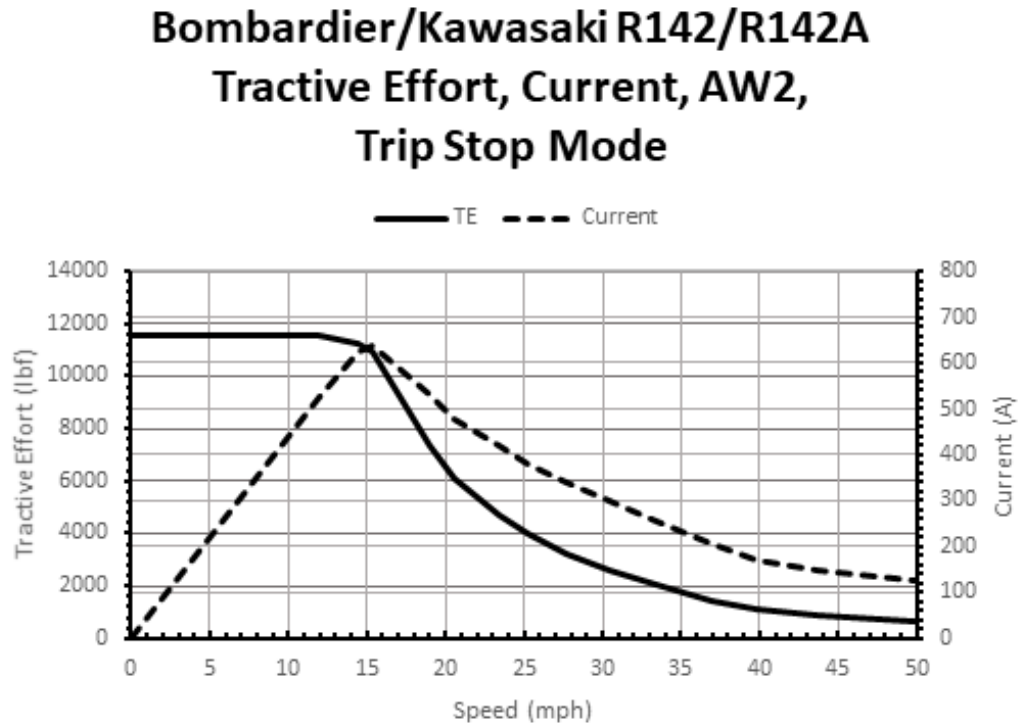
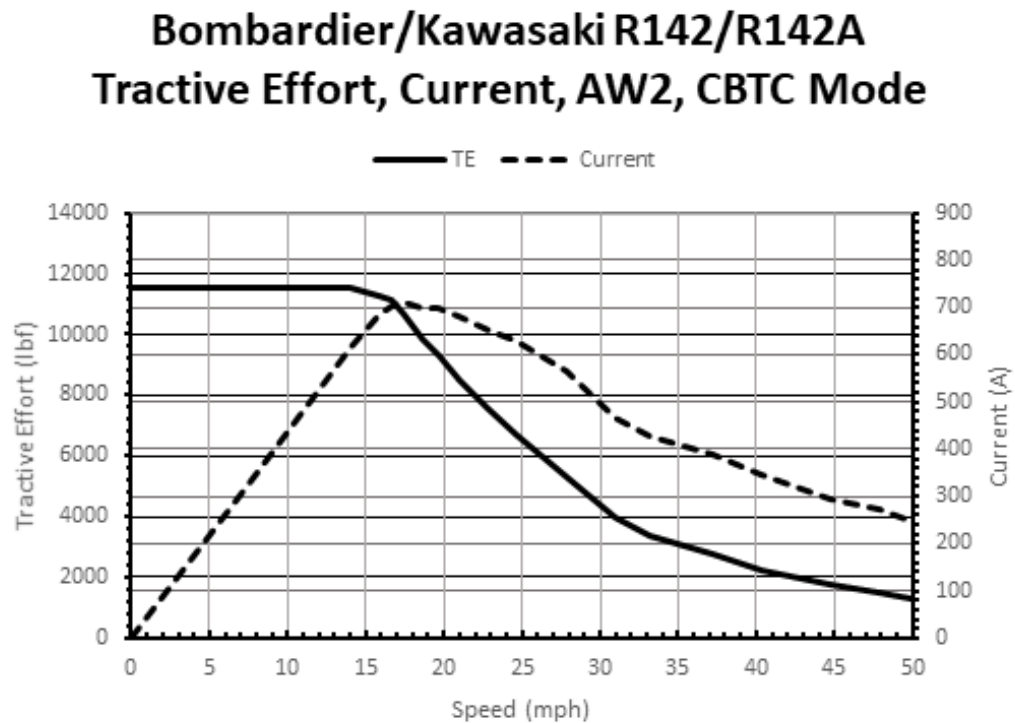


Figure F.1-3: TE/Current for R142/A Model at AW2, CBTC Mode



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Figure F.1-4: BE for R142/A Model at AW3, Trip Stop and CBTC Modes

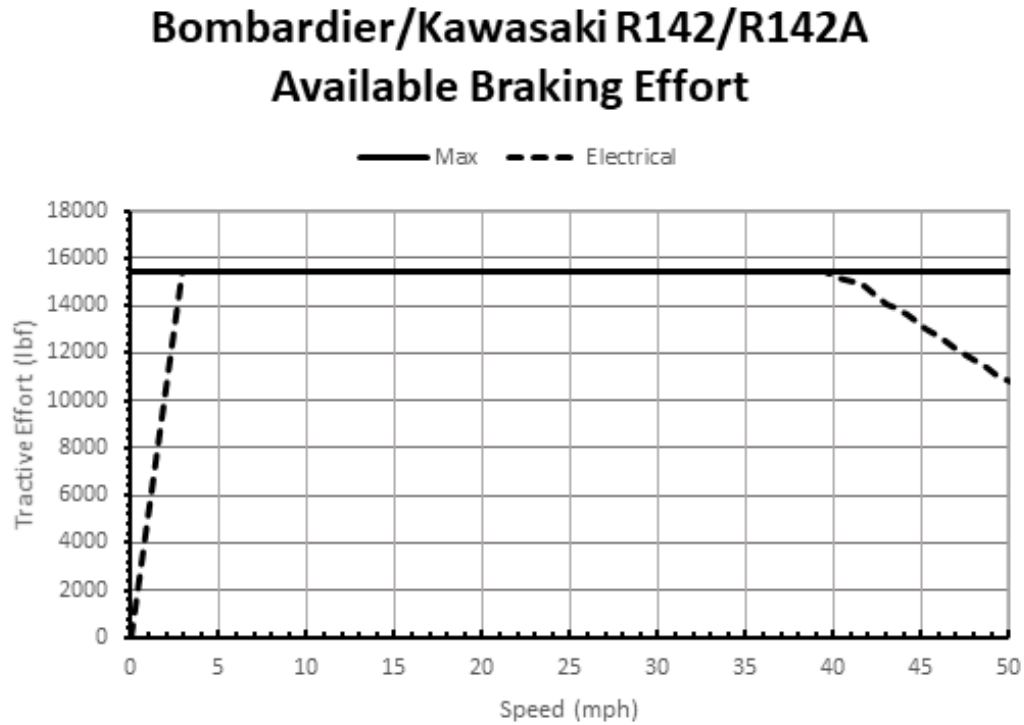
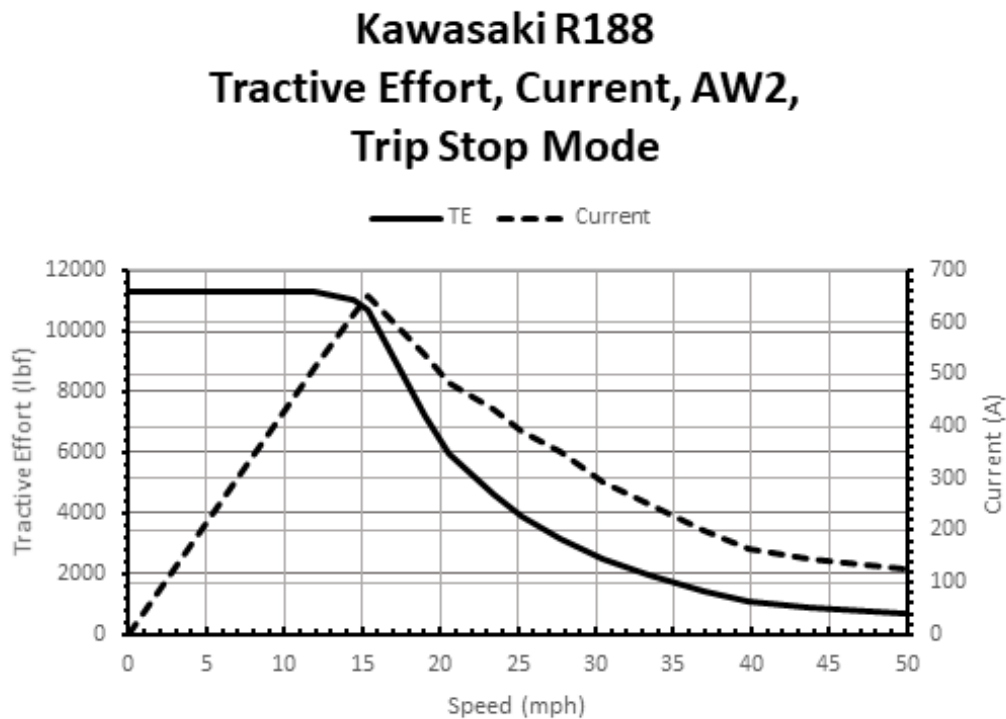


Figure F.1-5: TE/Current for R188 Model at AW2, Trip Stop Mode



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Figure F.1-6: TE/Current for R188 Model at AW2, CBTC Mode

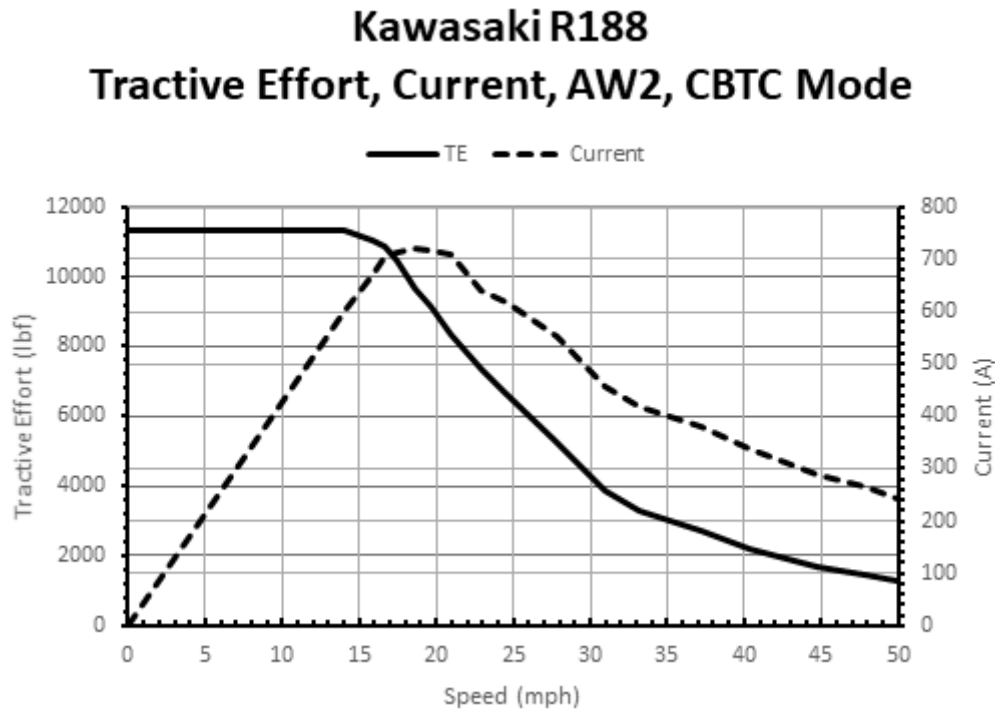
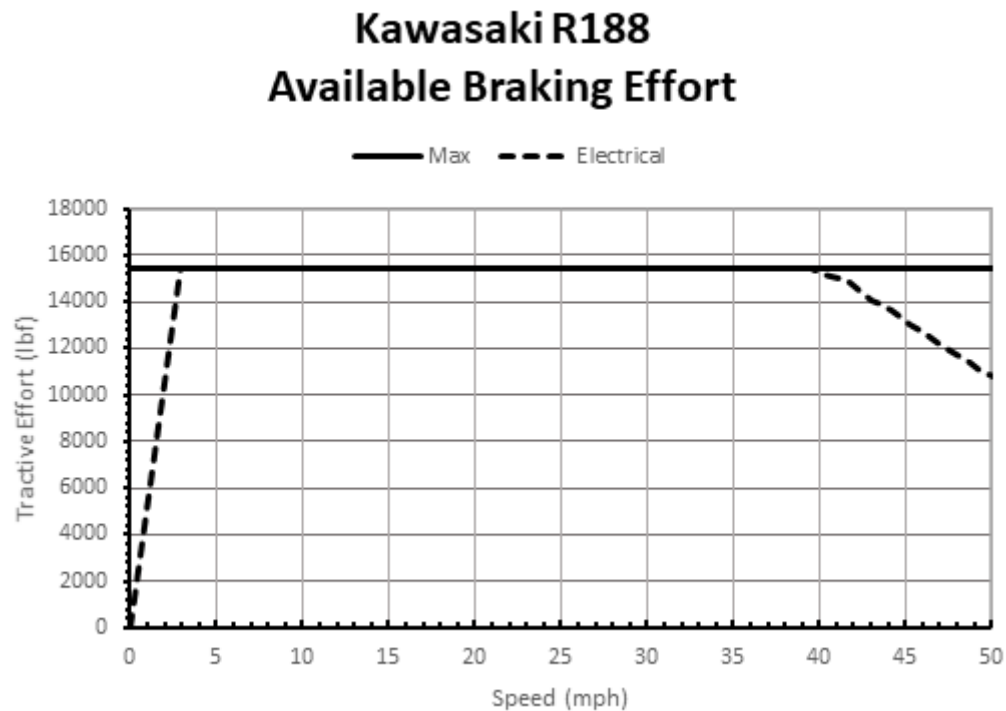


Figure F.1-7: BE for R188 Model at AW3, Trip Stop and CBTC Modes



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F.1.2 Infrastructure

Track alignment includes vertical profile (grades), horizontal alignment (curves), and points of switch. It also includes the underlying stationing/chainage system with associated equations (“equalities”) to account for disconnects in continuous stationing/chainage. Maximum operating speeds, which differ in terms of existing and CBTC operations, are also described below. These speeds differ because many speeds today are artificially constrained due to limited signal design braking distance ahead (requiring enforced speed restrictions to limit attainable speed with attendant reduction in required braking distance) and the intermittent nature of NYCT’s current speed enforcement technologies.

F.1.2.1 Grades and Curves

Grade data were compiled on a track-specific basis from the NYCT MOW Engineering (Signals Group) Single Line (SL) drawings. These drawings show each section of continuous vertical profile with the stationing/chainage of each grade change point. Grade data were cross-checked against spreadsheets provided by NYCT MOW Engineering (Track Group). Where discrepancies were noted, the grade data on the NYCT MOW Engineering (Signals Group) Single Line (SL) drawings were referenced. The SL drawing scale is less detailed than the corresponding DL drawing scale.

Curve data (horizontal alignment) were also provided by NYCT MOW Engineering (Track Group).

F.1.2.2 Points of Switch

NYCT points of switch locations were extracted from the NYCT MOW Engineering (Signals Group) Double Line (DL) drawings.

F.1.2.3 Chainage Equations

All grade, curve and points of switch data were entered in native engineering stationing/chainage values. These values are not track-specific but, rather, follow the nominal centerline of each NYCT line. Where discontinuities in engineering stationing/chainage exist, chainage equations are required.

The A-Division has several chainage equations and track designation changes as listed in Table F.1-2 below.

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Table F.1-2. A-Division Chainage Equations and Track Designation Changes

Station	Track Designation Before	Location/ Chainage Equation	Track Designation After
Borough Hall	E1/E4	120+55=297+00	E1/E4
Borough Hall	E1/E4	295+00	K2/K3
Borough Hall	E2/E3	110+00	M2/M3
Junius St	EM	202+23=411+61	EM
South Ferry Loop	MS	33+13=0+00	MVB
South Ferry Loop	MVB	20+80=32+50	M3
Fulton St	M2/M3	0+00=11+19	M2/M3
Brooklyn Bridge	M2/M3	0+00=0+00	MM2/MM3
Brooklyn Bridge – City Hall Loop	MM1	0+00=0+00	ML
Brooklyn Bridge – City Hall Loop	ML	14+08=0+00	MM4
Grand Central	MM1/MM2/MM3/MM4	153+45=0+00	L1/L2/L3/L4
125 St	L1/L4	248+00	J1/J4
125 St	L2/L3	248+00	P2/P3
Battery Park Loop	V1	215+17=0+00	MVA
Battery Park Loop	MVA	14+79=221+00	V4
Chambers St	K2/K3	172+00	V2/V3
Times Sq-42 St	V1/V2/V3/V4	0+00=197+57	B1/B2/B3/B4
96 St	B2/B3	343+01=0+00	F2/F3
96 St	B1/B4	343+01=0+00	BB1/BB4
West Farms Sq - E Tremont Av	F2/FM/F3	370+00	W2/WM/W3
E 180 St	W2	390+79.5=138+96	Y1
E 180 St	W3	392+00=140+16.5	Y2

F.1.2.4 Maximum Operating Speeds - Existing

Maximum operating speeds differ between current wayside signaling and future CBTC. The existing default maximum speed is 50 MPH. Speed restrictions, some enforced and some unenforced, are present at many locations on the alignment. Unenforced speed restrictions are denoted on both Single Line and Double Line drawings with signs of the type “XX Mi” where “XX” is a speed and “Mi” stands for MPH. This applies until another similar sign is encountered or an end of platform is reached or a “R10” (Resume Speed for 10-car Train) sign is reached or a “GT XX” sign is reached.

Another type of speed restriction is indicated by a “GT XX” sign where “XX” is a speed and “GT” stands for Grade Time. This speed applies from that point through the last signal that is in a continuous series marked as GT in the direction of travel. There can be a mix of enforced and unenforced speed restrictions in a particular station-to-station pair.

Additional speed restrictions are enforced by Wheel Detectors (WD), which are common on tight radius crossovers. Additional speed restrictions are enforced by “blind” train stops (train stops without signals), which are common at end-of-track locations.

All speed restrictions are enforced as “head end only.” This means that the Train Operator is free to begin accelerating when the front of the train reaches a more permissive speed sign. Train Operators are not obligated to monitor their train length and estimate the point at which the tail of their train has cleared a speed restriction. In some cases (typically beyond crossover locations, R10 (Resume Speed for 10-car Trains) signs are in service to guide the Train Operator.

APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Trains have no explicit speed restriction entering and leaving platforms, provided they are stopping at the platform. In the case of non-stop trains passing a platform edge, the head end of the train is limited to 15 MPH while passing the leaving end of the platform.

Future CBTC speeds are addressed in the separate Future Baseline Report.

F.1.2.5 Platform Limits

Platform limits were obtained from NYCT Double Line drawings. All simulated train consists stop at the leaving end of each station platform as they travel along their respective routes.

F.1.3 Signal System (Existing System for Calibration Purposes)

While the focus of the project is the planned CBTC system for the A-Division, a detailed TrainOps® representation of the existing wayside signal system is required for calibration purposes. After modeling the existing wayside signaling system across the full network, simulated velocity profiles for each line were compared to current vehicle event recorder data to verify that the existing signaling system was modeled correctly.

The completed Signal locations/type of control, signal control lines, timed signal attributes and interlocking route establishment/route release time data sources are detailed below.

F.1.3.1 Signal Locations and Type of Control

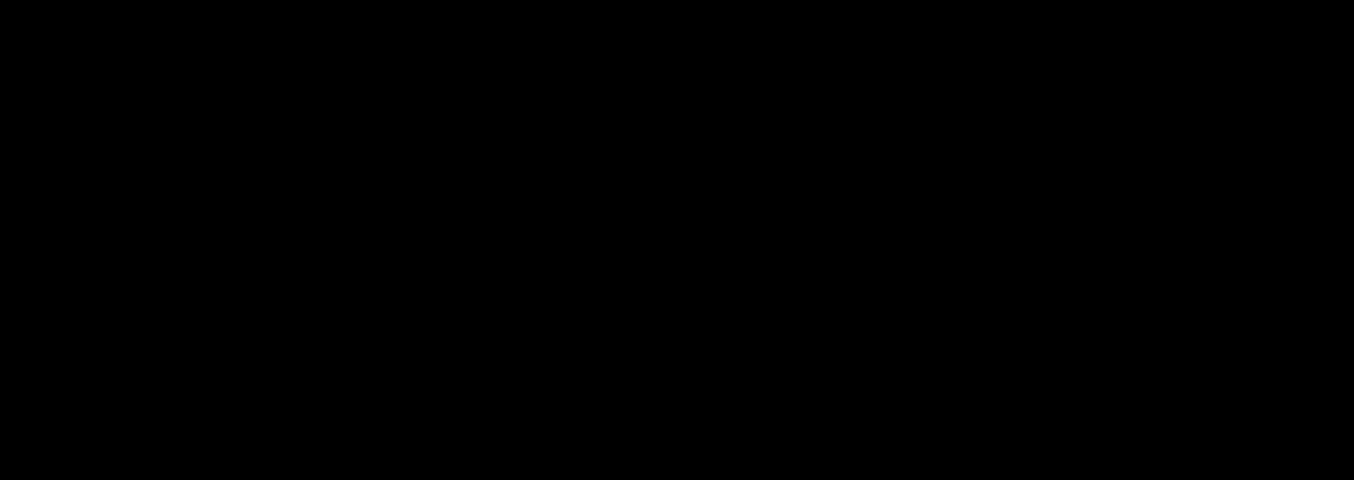
Wayside signal locations (including primary and reverse direction signals) as well as cut sections (insulated joints without wayside signals) are shown on both the Single Line and Double Line drawings. The Double Line drawings show the greatest clarity and are used as the primary source. The type of control (interlocking versus automatic) is also shown on the Double Line drawings.

F.1.3.2 Signal Control Lines

Signal control lines are shown on the Single Line drawings. These lines represent Caution Control Lines for which the corresponding track segments must be clear for the referenced signal to display yellow (Caution). In this occupancy situation, all other signals between the reference signal at the end of the control line and the occupied block (just beyond the arrow tip of the control line) display red (Stop). With some exceptions, described below, the signal prior to the referenced signal displays green (Proceed). Signal control lines are specific to each route and may include timed signal attributes (refer to Paragraph F.1.3.3 below).

The signal prior to the referenced signal will not display green (Proceed) if its best aspect is Caution. This is indicated by the signal symbols on both the Single Line and Double Line plans, applying to all occupancy conditions ahead.

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In addition, the signal prior to the referenced signal will not display green (Proceed) under the specific occupancy condition of the signal control line if Overlapped Distant Control applies. This concept repeats yellow aspects where signals are spaced close together and insufficient performance (not signal design) braking exists between successive signals.

F.1.3.3 Timed Signal Attributes

Timed signal types include:

- Grade Time signals;
- Station Time (ST) signals;
- Blind train stops; and
- Wheel Detector speed control.

Except for ST signals, the timed signal types referenced above enforce maximum operating speeds.

ST signaling provides a means of dynamically cutting back (shortening) signal control lines for train close-ins to an occupied block ahead, enhancing throughput. Figure F.1-8 illustrates a number of these signal concepts at an actual A-Division location. T shows the yellow (Caution) control lines which are comprised of solid control lines and, in some cases, dashed sections between two arrowheads. On Track 2, the full extents Caution control line for Signal 3282/D extends to the 3372/D location. The control line will be cut back from 3372/D to 3342/D if the circuit between these locations is occupied and a second approaching train satisfies the ST timer between 3252/D and 3282/D. The applicable ST timing sections (shown as a solid-dashed-solid line) are not attached to the actual ST signal but are, instead, offset vertically.

In contrast, the GT timing sections (shown as a continuously dashed line) are attached to the actual GT signal. While ST signals are almost exclusively “one shot” (having a single timing section), GT signals may be either “one-shot” or “two-shot” (having two timing

APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

sections where the satisfaction of either will cause the signal to clear). In Figure F.1-8, Signal 3312/D is a “one shot” GT while Signal 3252/D is a “two-shot” GT.

F.1.3.4 Interlocking Route Establishment and Release Times

Table F.1-3 is a list of all A-Division interlockings within the Phase I-IV study limits. NYCT directed that all interlockings operate on a first come, first served basis.

Table F.1-3. A-Division Interlockings

Line	Interlocking	Line Designation and Chain
Broadway	72 nd Street	B-272
	96 th Street	B-343
	103 rd Street	BB-13
	137 th Street	BB-110
	168 th Street	BB-191
	Dyckman Street	BB-274
	211 th Street	BB-306
	215 th Street	BB-318
	240 th Street	BB-395
7 th Avenue	Times Square	V-12
	14 th Street	V-79
	Chambers Street	V-165
	South Ferry	VA-219
Lenox Avenue	110 th Street	F-65
	141 st Street	F-147
	Lenox Avenue Yard	F-169
	149 th Street	F-180
	Jackson Avenue	F-238
Jerome Avenue	138 th Street	J-272
	149 th Street	J-292
	167 th Street	J-361
	Burnside	J-438
	Kingsbridge	J-501
	Jerome Yard	J-535
	Woodlawn	J-573
White Plains Road	East 180 th Street South	W-383
	East 180 th Street	W-390
	East 180 th Street Yard	W-395
	Bronx Park East	W-408
	219 th Street	W-546
	239 th Street	W-613
	Unionport Yard	W-UP
	239 th Street Yard	W-632
	239 th Street High Yard	W-620
Dyre Avenue	Morris Park	Y-175
	Dyre Avenue	Y-331

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Table F.1-3. A-Division Interlockings

Line	Interlocking	Line Designation and Chain
Pelham	3 rd Avenue	P-281
	Hunts Point Avenue	P-413
	East 177 th Street	P-526
	Westchester Square	P-589
	Pelham Bay Park	P-635
	Westchester Avenue Yard	PY-591
Lexington Avenue	Grand Central	L-9
	59 th Street	L-59
	86 th Street	L-134
	125 th Street	L-230
	Bowling Green	M-31
	Brooklyn Bridge	MM-10
	14 th Street	MM-98
Clark Street	Wall Street	K-208
Eastern Parkway	Borough Hall	E-114
	Nevins St	E-148
	Brooklyn Museum	E-223
	Nostrand Avenue	E-255
	Utica Avenue	E-320
	Junius Street	E-414
	New Lots	E-446
	Livonia Yard	E-475
Nostrand Avenue	President Street	D-272
	Church Avenue	D-334
	Flatbush Avenue	D-393

The TrainOps® simulation model was coded with a 5-second loss of shunt/route release time and a 12-second route establishment time for all interlockings though these values can be adjusted on an interlocking-specific basis. These values affect only sequential moves at interlockings where one train is waiting for another to clear an interlocking, such as the merging of the 4 Line with the 5 Line northbound at Nostrand Junction. The two values are additive so a train waiting to merge from a conflicting route will receive a proceed signal 17 seconds after the previous train has cleared the interlocking limits, starting the route release process.

F.1.4 Operations

F.1.4.1 Schedules

The simulated A-Division operating plans were imported into TrainOps® from NYCT Rapid Timetable Interchange Format (RTIF) data sources. NYCT provided the RTIF files shown in Table F.1-4 for use in the project.

APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

**Table F.1-4. NYCT RTIF Existing Operating Plan Source Files
for A-Division Simulation**

Line	Description	Effective Date
1	Broadway-7 Av Local	May 2, 2018
2	Broadway-7 Av Express	May 15, 2018
3	Broadway-7 Av Express	May 15, 2018
4	Lex Av Express	May 25, 2018
5	Lex Av Express	May 15, 2018
6	Lex Av Local	May 15, 2015
S	Grand Central – Times Square Shuttle	March 23, 2017

F.1.4.2 Passenger Loads

The simulated A-Division fleets have load weighing capabilities that generally adjust tractive effort and braking effort to achieve comparable performance for a range of passenger loading conditions. Only at “Standing Heavy” loads do A-Division cars experience modestly degraded acceleration and deceleration. Referring to the passenger capacities per car in Table F.1-1, the following Simulated Passenger Load definitions referenced in Table F.1-5 apply:

- Seated: All seats occupied by passengers;
- Standing Light: All seats occupied by passengers and one-third of maximum standing space occupied by passengers;
- Standing Medium: All seats occupied by passengers and two-thirds of maximum standing space occupied by passengers; and
- Standing Heavy: All seats occupied by passengers and all standing space occupied by passengers.

Table F.1-5 summarizes the assumed passenger load in simulation by A-Division Line, direction, and trip start time. Simulated passenger loads are uniform for an entire trip, unlike real-world operation in which passenger loads vary throughout the course of the trip.

Consistent with the NYCT RTIF file input, some of the 5 Line trips are considered as 5X trips (express in the Bronx). Similarly, some of the 6 Line trips are considered as 6X trips (express in the Bronx).

Table F.1-5. A-Division Assumed Passenger Loadings by Line, Direction and Time

Line	Direction	Start Time	End Time	Simulated Passenger Load
1	N	0:00	6:00	Seated
1	S	0:00	6:00	Seated
1	N	6:00	9:00	Standing Light
1	S	6:00	9:00	Standing Medium
1	N	9:00	16:00	Standing Light

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Table F.1-5. A-Division Assumed Passenger Loadings by Line, Direction and Time

Line	Direction	Start Time	End Time	Simulated Passenger Load
1	S	9:00	16:00	Standing Light
1	N	16:00	19:00	Standing Medium
1	S	16:00	19:00	Standing Light
1	N	19:00	0:00	Seated
1	S	19:00	0:00	Seated
2	N	0:00	6:00	Seated
2	S	0:00	6:00	Seated
2	N	6:00	9:00	Standing Medium
2	S	6:00	9:00	Standing Medium
2	N	9:00	16:00	Standing Light
2	S	9:00	16:00	Standing Light
2	N	16:00	19:00	Standing Medium
2	S	16:00	19:00	Standing Medium
2	N	19:00	0:00	Seated
2	S	19:00	0:00	Seated
3	N	0:00	6:00	Seated
3	S	0:00	6:00	Seated
3	N	6:00	9:00	Standing Medium
3	S	6:00	9:00	Standing Medium
3	N	9:00	16:00	Standing Light
3	S	9:00	16:00	Standing Light
3	N	16:00	19:00	Standing Medium
3	S	16:00	19:00	Standing Medium
3	N	19:00	0:00	Seated
3	S	19:00	0:00	Seated
4	N	0:00	6:00	Seated
4	S	0:00	6:00	Seated
4	N	6:00	9:00	Standing Heavy
4	S	6:00	9:00	Standing Heavy
4	N	9:00	16:00	Standing Light
4	S	9:00	16:00	Standing Light
4	N	16:00	19:00	Standing Heavy
4	S	16:00	19:00	Standing Heavy
4	N	19:00	0:00	Seated
4	S	19:00	0:00	Seated
5	N	0:00	6:00	Seated
5	S	0:00	6:00	Seated
5	N	6:00	9:00	Standing Heavy
5	S	6:00	9:00	Standing Heavy
5	N	9:00	16:00	Standing Light
5	S	9:00	16:00	Standing Light
5	N	16:00	19:00	Standing Heavy
5	S	16:00	19:00	Standing Heavy
5	N	19:00	0:00	Seated
5	S	19:00	0:00	Seated

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Table F.1-5. A-Division Assumed Passenger Loadings by Line, Direction and Time

Line	Direction	Start Time	End Time	Simulated Passenger Load
5X	N	0:00	6:00	Seated
5X	S	0:00	6:00	Seated
5X	N	6:00	9:00	Standing Heavy
5X	S	6:00	9:00	Standing Heavy
5X	N	9:00	16:00	Standing Light
5X	S	9:00	16:00	Standing Light
5X	N	16:00	19:00	Standing Heavy
5X	S	16:00	19:00	Standing Heavy
5X	N	19:00	0:00	Seated
5X	S	19:00	0:00	Seated
6	N	0:00	6:00	Seated
6	S	0:00	6:00	Seated
6	N	6:00	9:00	Standing Medium
6	S	6:00	9:00	Standing Medium
6	N	9:00	16:00	Standing Light
6	S	9:00	16:00	Standing Light
6	N	16:00	19:00	Standing Medium
6	S	16:00	19:00	Standing Medium
6	N	19:00	0:00	Seated
6	S	19:00	0:00	Seated
6X	N	0:00	6:00	Seated
6X	S	0:00	6:00	Seated
6X	N	6:00	9:00	Standing Medium
6X	S	6:00	9:00	Standing Medium
6X	N	9:00	16:00	Standing Light
6X	S	9:00	16:00	Standing Light
6X	N	16:00	19:00	Standing Medium
6X	S	16:00	19:00	Standing Medium
6X	N	19:00	0:00	Seated
6X	S	19:00	0:00	Seated
S	N	0:00	6:00	Seated
S	S	0:00	6:00	Seated
S	N	6:00	9:00	Standing Medium
S	S	6:00	9:00	Standing Medium
S	N	9:00	16:00	Standing Medium
S	S	9:00	16:00	Standing Medium
S	N	16:00	19:00	Standing Medium
S	S	16:00	19:00	Standing Medium
S	N	19:00	0:00	Seated
S	S	19:00	0:00	Seated

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F.1.4.3 Train Consists

All simulated train consists are 10 cars, except for the 42 Street Shuttle consists that are 6 cars. The ① Line, ③ Line and ⑥ Line operate exclusively R62/R62A cars, while the ② Line, ④ Line and ⑤ Line operate exclusively R142/R142A cars. As was noted in Paragraph F.1.1, the R142/R142A performance is superior to that of the R62/R62A.

F.1.4.4 Dwell Times

The NYCT Operations Planning developed an extensive database of median dwell times specific to stations, lines, directions, and times of day. This was based on ATS data and the use of conversion factors to convert track circuit occupancy (“trigger points”) into actual wheel stop/wheel start dwell times. The data NYCT provided reflects median dwell times ranging from 20 to 60 seconds in 5-second increments, of which about 12 seconds is Conductor reaction time to open the doors, door cycle time and Train Operator reaction time to begin moving the train. Dwell times vary by time of day (morning peak period, evening peak period or off-peak), by direction, by track and by line.

The longest simulated dwells are at the following locations:

- President Street (60 seconds northbound in the evening)
- Grand Central - 42 Street (55 seconds northbound on Track 3 in the evening, 50 seconds southbound on Track 2 in the morning)
- 14 Street - Union Square (50 seconds southbound on Track 1 in the evening, 50 seconds southbound on Track 2 in both the morning and evening)
- East 180 Street (65 seconds northbound on Track 3 in the evening)

The dwell times at President Street and East 180 Street may reflect wait time for interlocking routes, in addition to traditional passenger movement time and door cycle time. Because TrainOps® inherently captures junction delays in its modeling of the signaling system, dwell times at these locations may add some conservatism to the resultant simulation results. A minimum dwell of 20 seconds was conservatively assigned even if ATS data showed a lower average dwell. The resultant dwells for simulation are shown in Table F.1-6 (the ①, ② and ③ Lines) and Table F.1-7 (the ④, ⑤ and ⑥ Lines).

NYCT provided overnight service dwell times which are reflected in Table F.1-6 and Table F.1-7 such as for the ④ Line that provides local service between Crown Heights - Utica Avenue and New Lots Avenue when the ③ Line is not operating.

APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Table F.1-6. Dwell Time Inputs 1, 2 and 3 Lines

Station	Track	Dir	1 Line			2 Line			3 Line		
			AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak
Nevins St	1	S				30	35	30	30	35	30
Nevins St	4	N				30	25	25	30	25	25
Atlantic Av	1	S				25	35	25	25	35	25
Atlantic Av	4	N				35	25	25	35	25	25
Bergen St	1	S				20	20	20	20	20	20
Bergen St	4	N				20	20	20	20	20	20
Grand Army Plaza	1	S				25	25	25	25	25	25
Grand Army Plaza	4	N				25	20	20	25	20	20
Eastern Pkwy-Brooklyn Museum	1	S				25	25	25	25	25	25
Eastern Pkwy-Brooklyn Museum	4	N				20	20	20	20	20	20
Franklin Av	1	S				35	40	30	35	40	30
Franklin Av	4	N				35	35	35	35	35	35
President St	2	S				30	30	30			
President St	3	N				50	60	40			
Sterling St	2	S				20	20	20			
Sterling St	3	N				20	20	20			
Winthrop St	2	S				20	20	20			
Winthrop St	3	N				20	20	20			
Church Av	2	S				30	30	30			
Church Av	3	N				30	25	25			
Beverly Rd	2	S				25	20	25			
Beverly Rd	3	N				20	20	20			
Newkirk Av	2	S				30	30	30			
Newkirk Av	3	N				20	20	20			
Nostrand Av	1	S				25	30	25	25	30	25
Nostrand Av	4	N				30	40	25	30	40	25
Kingston Av	1	S				20	25	20	20	25	20
Kingston Av	4	N				20	20	20	20	20	20
Crown Heights - Utica Av	1	S				30	40	35	30	40	35
Crown Heights - Utica Av	4	N				40	45	30	40	45	30
Sutter Av - Rutland Rd	1	S				20	25	20	20	25	20
Sutter Av - Rutland Rd	4	N				25	20	20	25	20	20
Saratoga Av	1	S				25	30	30	25	30	30
Saratoga Av	4	N				35	30	30	35	30	30
Rockaway Av	1	S				20	25	20	20	25	20
Rockaway Av	4	N				25	20	20	25	20	20
Junius St	1	S				20	25	20	20	25	20
Junius St	4	N				20	20	20	20	20	20
Pennsylvania Av	1	S				20	25	20	20	25	20
Pennsylvania Av	4	N				20	20	20	20	20	20
Van Siclen Av	1	S				25	30	25	25	30	25
Van Siclen Av	4	N				20	20	20	20	20	20
Hoyt St	1	S				20	20	20	20	20	20
Hoyt St	4	N				25	20	20	25	20	20
Borough Hall	2	S				20	25	20	20	25	20
Borough Hall	3	N				25	25	25	25	25	25
Clark St	2	S				20	25	20	20	25	20
Clark St	3	N				25	25	20	25	25	20
Wall St	2	S				30	30	25	30	30	25

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Table F.1-6. Dwell Time Inputs 1, 2 and 3 Lines

Station	Track	Dir	1 Line			2 Line			3 Line		
			AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak
Wall St	3	N				30	35	30	30	35	30
Fulton St	2	S				35	35	30	35	35	30
Fulton St	3	N				30	35	30	30	35	30
Park Pl	2	S				30	30	25	30	30	25
Park Pl	3	N				30	40	30	30	40	30
Rector St	1	S	25	20	25						
Rector St	4	N	20	20	20						
Cortlandt St	1	S	20	20	20						
Cortlandt St	4	N	20	20	20						
Chambers St	1	S	30	25	25						
Chambers St	2	S				35	30	30	35	30	30
Chambers St	3	N				30	35	30	30	35	30
Chambers St	4	N	25	25	25						
Franklin St	1	S	20	20	20			20			
Franklin St	4	N	20	20	20			20			
Canal St	1	S	20	20	20			20			
Canal St	4	N	20	20	20			20			
Houston St	1	S	20	20	20			20			
Houston St	4	N	20	25	20			20			
Christopher St-Sheridan Sq	1	S	20	20	20			20			
Christopher St-Sheridan Sq	4	N	20	20	20			20			
14 St	1	S	30	25	25			25			
14 St	2	S				30	25	25	30	25	25
14 St	3	N				25	35	25	25	35	25
14 St	4	N	30	30	25			25			
18 St	1	S	20	20	20			20			
18 St	4	N	20	25	20			20			
23 St	1	S	20	20	20			20			
23 St	4	N	20	25	20			20			
28 St	1	S	20	20	20			20			
28 St	4	N	20	25	20			20			
34 St-Penn Station	1	S	30	30	30			30			
34 St-Penn Station	2	S				35	35	30	35	35	30
34 St-Penn Station	3	N				40	45	30	40	45	30
34 St-Penn Station	4	N	35	35	25			25			
Times Sq-42 St	1	S	50	50	40			40			
Times Sq-42 St	2	S				50	50	35	50	50	35
Times Sq-42 St	3	N				45	50	35	45	50	35
Times Sq-42 St	4	N	45	50	35			35			
50 St	1	S	25	25	20			20			
50 St	4	N	25	30	25			25			
59 St-Columbus Circle	1	S	35	30	30			30			
59 St-Columbus Circle	4	N	30	35	30			30			
66 St	1	S	25	25	20			20			
66 St	4	N	20	25	20			20			
72 St	1	S	35	30	30			30			
72 St	2	S				35	30	25	35	30	25
72 St	3	N				25	35	25	25	35	25
72 St	4	N	30	35	30			30			

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Table F.1-6. Dwell Time Inputs ①, ② and ③ Lines

Station	Track	Dir	① Line			② Line			③ Line		
			AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak
79 St	1	S	25	20	20			20			
79 St	4	N	20	20	20			20			
86 St	1	S	20	20	20			20			
86 St	4	N	20	25	20			20			
96 St	1	S	40	35	35			35			
96 St	2	S				40	30	30	40	30	30
96 St	3	N				30	35	30	30	35	30
96 St	4	N	30	45	30			30			
103 St	1	S	25	20	20						
103 St	4	N	20	25	20						
Cathedral Pkwy-110 St	1	S	25	20	20						
Cathedral Pkwy-110 St	4	N	20	25	20						
116 St-Columbia University	1	S	20	20	20						
116 St-Columbia University	4	N	20	20	20						
125 St	1	S	20	20	20						
125 St	4	N	20	20	20						
137 St-City College	1	S	30	20	30						
137 St-City College	4	N	25	30	25						
145 St	1	S	20	20	20						
145 St	4	N	20	20	20						
157 St	1	S	25	20	20						
157 St	4	N	20	20	20						
168 St	1	S	20	20	20						
168 St	4	N	20	20	20						
181 St	1	S	25	20	20						
181 St	4	N	20	25	20						
191 St	1	S	20	20	20						
191 St	4	N	20	20	20						
Dyckman St	1	S	20	20	20						
Dyckman St	4	N	20	20	20						
207 St	1	S	20	20	20						
207 St	4	N	20	20	20						
215 St	1	S	20	20	20						
215 St	4	N	20	20	20						
Marble Hill-225 St	1	S	20	20	20						
Marble Hill-225 St	4	N	20	20	20						
231 St	1	S	25	20	20						
231 St	4	N	20	25	20						
238 St	1	S	20	20	20						
238 St	4	N	20	25	25						
Central Park North-110 St	2	S				25	25	25	25	25	25
Central Park North-110 St	3	N				30	35	30	30	35	30
116 St ② ③	2	S				25	25	25	25	25	25
116 St ② ③	3	N				20	25	20	20	25	20
125 St ② ③	2	S				25	25	20	25	25	20
125 St ② ③	3	N				25	30	25	25	30	25
135 St	2	S				25	25	25	25	25	25
135 St	3	N				30	40	30	30	40	30
145 St ③	1	S							25	25	25

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Table F.1-6. Dwell Time Inputs ①, ② and ③ Lines

Station	Track	Dir	① Line			② Line			③ Line		
			AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak
145 St ③	4	N							30	45	30
149 St-Grand Concourse	2	S				50	40	45			
149 St-Grand Concourse	3	N				25	35	25			
3 Av-149 St	2	S				40	25	25			
3 Av-149 St	3	N				25	35	25			
Jackson Av	2	S				40	25	25			
Jackson Av	3	N				25	25	25			
Prospect Av	2	S				25	20	25			
Prospect Av	3	N				20	25	20			
Intervale Av	2	S				20	20	20			
Intervale Av	3	N				20	20	20			
Simpson St	2	S				30	30	30			
Simpson St	3	N				25	30	30			
Freeman St	2	S				20	20	20			
Freeman St	3	N				20	20	20			
174 St	2	S				25	25	25			
174 St	3	N				25	25	25			
West Farms Sq-E Tremont Av	2	S				30	30	30			
West Farms Sq-E Tremont Av	3	N				30	30	30			
E 180 St	2	S				40	35	35			
E 180 St	3	N				45	65	55			
Bronx Park East	2	S				30	25	25			
Bronx Park East	3	N				20	20	20			
Pelham Pkwy ② ⑤	2	S				20	20	20			
Pelham Pkwy ② ⑤	3	N				20	25	20			
Allerton Av	2	S				25	25	25			
Allerton Av	3	N				20	20	20			
Burke Av	2	S				20	20	20			
Burke Av	3	N				20	20	20			
Gun Hill Rd ② ⑤	2	S				25	25	25			
Gun Hill Rd ② ⑤	3	N				25	30	30			
219 St	2	S				20	20	20			
219 St	3	N				20	20	20			
225 St ② ⑤	2	S				20	20	20			
225 St ② ⑤	3	N				20	25	25			
233 St	2	S				20	20	20			
233 St	3	N				20	20	20			
Nereid Av	2	S				25	25	25			
Nereid Av	3	N				25	30	35			

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Table F.1-7. Dwell Time Inputs ④, ⑤ and ⑥ Lines

Station	Track	Dir	④ Line			⑤ Line			⑥ Line		
			AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak
Nevins St	2	S	25	30	30	25	30	30			
Nevins St	3	N	30	25	25	30	25	25			
Atlantic Av	1	S			25						
Atlantic Av	2	S	25	35	25	25	35	25			
Atlantic Av	3	N	45	35	35	45	35	35			
Atlantic Av	4	N			25						
Bergen St	1	S			20						
Bergen St	4	N			20						
Grand Army Plaza	1	S			25						
Grand Army Plaza	4	N			20						
Eastern Pkwy-Brooklyn Museum	1	S			25						
Eastern Pkwy-Brooklyn Museum	4	N			20						
Franklin Av	1	S			30						
Franklin Av	2	S	25	35	25	25	35	25			
Franklin Av	3	N	35	30	30	35	30	30			
Franklin Av	4	N			35						
President St	2	S				30	30	30			
President St	3	N				50	60	40			
Church Av	2	S				30	30	30			
Church Av	3	N				30	25	25			
Beverly Rd	2	S				25	20	25			
Beverly Rd	3	N				20	20	20			
Newkirk Av	2	S				30	30	30			
Newkirk Av	3	N				20	20	20			
Nostrand Av	1	S			25						
Nostrand Av	4	N			25						
Kingston Av	1	S			20						
Kingston Av	4	N			20						
Crown Heights - Utica Av	1	S			35						
Crown Heights - Utica Av	4	N			30						
Sutter Av - Rutland Rd	1	S			20	20	25	20			
Sutter Av - Rutland Rd	4	N			20	25	20	20			
Saratoga Av	1	S			30	25	30	30			
Saratoga Av	4	N			30	35	30	30			
Rockaway Av	1	S			20	20	25	20			
Rockaway Av	4	N			20	25	20	20			
Junius St	1	S			20	20	25	20			
Junius St	4	N			20	20	20	20			
Pennsylvania Av	1	S			20	20	25	20			
Pennsylvania Av	4	N			20	20	20	20			
Van Siclen Av	1	S			25	25	30	25			
Van Siclen Av	4	N			20	20	20	20			
138 St - Grand Concourse	1	S	40	25	25	40	25	25			
138 St - Grand Concourse	4	N	45	40	45	45	40	45			
Fulton St	2	S	35	35	30	35	35	30			
Fulton St	3	N	35	35	25	35	35	25			
Wall St	2	S	30	35	30	30	35	30			
Wall St	3	N	30	30	25	30	30	25			
Bowling Green	2	S	30	35	30	30	35	30			

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Table F.1-7. Dwell Time Inputs ④, ⑤ and ⑥ Lines

Station	Track	Dir	④ Line			⑤ Line			⑥ Line		
			AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak
Bowling Green	3	N	35	35	25	35	35	25			
Borough Hall	2	S	30	35	30	30	35	30			
Borough Hall	3	N	35	30	30	35	30	30			
3 Av - 138 St	2	S							35	20	20
3 Av - 138 St	M	S							30		20
3 Av - 138 St	M	N								30	30
3 Av - 138 St	3	N							25	35	30
125 St	1	S	45	30	30	45	30	30			
125 St	2	S							40	30	30
125 St	3	N	35	45	35	35	45	35			
125 St	4	N			35				30	50	35
116 St	1	S			25				30	25	25
116 St	4	N			25				25	30	25
110 St	1	S			20				25	20	20
110 St	4	N			20				20	25	20
103 St	1	S			20				25	20	20
103 St	4	N			20				20	25	20
96 St	1	S			25				30	25	25
96 St	4	N			20				20	25	20
86 St	1	S			25				30	30	25
86 St	2	S	35	30	30	35	30	30			
86 St	3	N	30	35	30	30	35	30			
86 St	4	N			20				20	30	20
77 St	1	S			30				30	35	30
77 St	4	N			20				25	30	20
68 St - Hunter College	1	S			20				25	30	20
68 St - Hunter College	4	N			20				25	30	20
59 St	1	S			25				35	35	25
59 St	2	S	40	35	30	40	35	30			
59 St	3	N	30	35	30	30	35	30			
59 St	4	N			25				30	35	25
51 St	1	S			30				35	40	30
51 St	4	N			25				35	40	25
Grand Central - 42 St	1	S			40				45	45	40
Grand Central - 42 St	2	S	50	45	40	50	45	40			
Grand Central - 42 St	3	N	45	55	40	45	55	40			
Grand Central - 42 St	4	N			35				40	45	35
33 St	1	S			25				25	25	25
33 St	4	N			25				25	35	25
28 St	1	S			25				30	30	25
28 St	4	N			25				25	30	25
23 St	1	S			20				25	25	20
23 St	4	N			20				20	25	20
14 St - Union Sq	1	S			40				40	50	40
14 St - Union Sq	2	S	50	50	45	50	50	45			
14 St - Union Sq	3	N	45	45	35	45	45	35			
14 St - Union Sq	4	N			35				40	40	35
Astor Pl	1	S			20				20	25	20
Astor Pl	4	N			25				25	30	25

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Table F.1-7. Dwell Time Inputs 4, 5 and 6 Lines

Station	Track	Dir	4 Line			5 Line			6 Line		
			AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak
Bleecker St	1	S			20				20	25	20
Bleecker St	4	N			25				30	25	25
Spring St	1	S			20				20	20	20
Spring St	4	N			20				20	25	20
Canal St	1	S			20				20	20	20
Canal St	4	N			30				25	30	30
Brooklyn Bridge	2	S	30	30	25	30	30	25			
Brooklyn Bridge	3	N	25	30	25	25	30	25			
149 St-Grand Concourse 4	1	S	50	40	40						
149 St-Grand Concourse 4	4	N	35	50	40						
161 St-Yankee Stadium	1	S	45	55	40						
161 St-Yankee Stadium	4	N	30	45	30						
167 St	1	S	30	25	25						
167 St	4	N	20	25	25						
170 St	1	S	25	20	20						
170 St	4	N	20	25	25						
Mt Eden Av	1	S	20	20	20						
Mt Eden Av	4	N	20	25	20						
176 St	1	S	20	20	20						
176 St	4	N	20	20	20						
Burnside Av	1	S	25	25	25						
Burnside Av	4	N	25	25	25						
183 St	1	S	20	20	20						
183 St	4	N	20	25	25						
Fordham Rd	1	S	20	20	20						
Fordham Rd	4	N	20	25	25						
Kingsbridge Rd	1	S	25	20	25						
Kingsbridge Rd	4	N	25	25	25						
Bedford Pk Blvd	1	S	20	20	25						
Bedford Pk Blvd	4	N	25	25	25						
Mosholu Pkwy	1	S	20	20	25						
Mosholu Pkwy	4	N	25	25	25						
149 St-Grand Concourse 2 5	2	S				50	40	45			
149 St-Grand Concourse 2 5	3	N				25	35	25			
3 Av-149 St	2	S				40	25	25			
3 Av-149 St	3	N				25	35	25			
Jackson Av	2	S				40	25	25			
Jackson Av	3	N				25	25	25			
Prospect Av	2	S				25	20	25			
Prospect Av	3	N				20	25	20			
Intervale Av	2	S				20	20	20			
Intervale Av	3	N				20	20	20			
Simpson St	2	S				30	30	30			
Simpson St	3	N				25	30	30			
Freeman St	2	S				20	20	20			
Freeman St	3	N				20	20	20			
174 St	2	S				25	25	25			
174 St	3	N				25	25	25			
West Farms Sq-E Tremont Av	2	S				30	30	30			

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Table F.1-7. Dwell Time Inputs ④, ⑤ and ⑥ Lines

Station	Track	Dir	④ Line			⑤ Line			⑥ Line		
			AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak
West Farms Sq-E Tremont Av	3	N				30	30	30			
E 180 St	2	S				40	35	35			
E 180 St	M	S				40		75			
E 180 St	M	N						95			
E 180 St	3	N				45	65	55			
Bronx Park East	2	S				30	25	25			
Bronx Park East	3	N				20	20	20			
Pelham Pkwy ② ⑤	2	S				20	20	20			
Pelham Pkwy ② ⑤	3	N				20	25	20			
Allerton Av	2	S				25	25	25			
Allerton Av	3	N				20	20	20			
Burke Av	2	S				20	20	20			
Burke Av	3	N				20	20	20			
Gun Hill Rd ② ⑤	2	S				25	25	25			
Gun Hill Rd ② ⑤	3	N				25	30	30			
219 St	2	S				20	20	20			
219 St	3	N				20	20	20			
225 St ② ⑤	2	S				20	20	20			
225 St ② ⑤	3	N				20	25	25			
233 St	2	S				20	20	20			
233 St	3	N				20	20	20			
Nereid Av	2	S				25	25	25			
Nereid Av	3	N				25	30	35			
Morris Park	1	S				20	20	20			
Morris Park	2	N				20	20	25			
Pelham Pkwy ⑤	1	S				20	20	20			
Pelham Pkwy ⑤	2	N				20	20	20			
Gun Hill Rd ⑤	1	S				25	20	20			
Gun Hill Rd ⑤	2	N				20	20	20			
Baychester Av	1	S				25	20	20			
Baychester Av	2	N				20	20	20			
Brook Av	2	S							25	20	20
Brook Av	3	N							20	20	20
Cypress Av	2	S							20	20	20
Cypress Av	3	N							20	20	20
E 143 St-St Mary's St	2	S							20	20	20
E 143 St-St Mary's St	3	N							20	20	20
E 149 St	2	S							20	20	20
E 149 St	3	N							20	20	20
Longwood Av	2	S							20	20	20
Longwood Av	3	N							20	20	20
Hunts Point Av	2	S							40	25	30
Hunts Point Av	M	S							40		30
Hunts Point Av	M	N								35	35
Hunts Point Av	3	N							30	40	35
Whitlock Av	2	S							20	20	20
Whitlock Av	3	N							20	20	20
Elder Av	2	S							20	20	20
Elder Av	3	N							20	20	20

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Table F.1-7. Dwell Time Inputs ④, ⑤ and ⑥ Lines

Station	Track	Dir	④ Line			⑤ Line			⑥ Line		
			AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak
Morrison Av-Soundview	2	S							20	20	20
Morrison Av-Soundview	3	N							20	20	20
St Lawrence Av	2	S							20	20	20
St Lawrence Av	3	N							20	25	20
Parkchester	2	S							20	20	20
Parkchester	M	S							35		30
Parkchester	M	N								55	55
Parkchester	3	N							25		30
Castle Hill Av	2	S							20	20	20
Castle Hill Av	3	N							20	20	20
Zerega Av	2	S							20	20	20
Zerega Av	3	N							20	20	20
Westchester Sq-E Tremont Av	2	S							20	20	20
Westchester Sq-E Tremont Av	3	N							20	20	20
Middletown Rd	2	S							25	25	25
Middletown Rd	3	N							25	30	25
Buhre Av	2	S							20	20	20
Buhre Av	3	N							20	20	20

F.1.4.5 Terminal Turn Times

The simulation model has the following locations where trains “turn” (change direction) at terminals:

- New Lots Avenue;
- Utica Avenue (using relay tail tracks);
- Flatbush Avenue - Brooklyn College;
- 3 Avenue - 138 Street Center Track (limited ⑥ Line trips in the peak period);
- South Ferry;
- Times Square - 42 Street (limited ③ Line trips during late nights using relay tracks);
- Harlem - 148 Street;
- Van Cortlandt Park - 242 Street;
- Woodlawn;
- Wakefield - 241 Street;
- Eastchester - Dyre Avenue;

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- Parkchester (using relay tracks); and
- Pelham Bay Park.

NYCT directed that 90 seconds serve as the minimum turn time at these locations when train crews are striving to recover from accrued lateness. At Utica Avenue, this applies solely to the time on the tail track. NYCT tries to schedule a 9- to 10-minute minimum turn time at Utica Avenue, including time from letting passengers off, relaying, and wheel start for departure in relay position. These turns involve a switch crew at both ends of the train to make the turn on the relay track in 90 seconds. At New Lots Avenue and Flatbush Avenue - Brooklyn College, all turns involve the use of dropback road crews.

In addition, the tail (fifth) track at Atlantic Avenue is used for “turning” non-revenue trains operating between Livonia Yard and Flatbush Avenue - Brooklyn College. This is accomplished with a single crew; NYCT directed that a minimum turn time of 10 minutes be assumed at this location, given that the Train Operator must walk the length of the train.

The tail (fifth) track at Times Square - 42 Street is also used overnight for turning 3 Line trains operating between Times Square - 42 Street and Harlem - 148 Street. This is accomplished with a single crew; NYCT directed that a minimum turn time of 8 minutes be assumed at this location, given that the Train Operator must walk the length of the train.

NYCT directed that a minimum turn time of 8 minutes be assumed at the following locations for yard put-ins and lay-ups:

- 137 Street Yard;
- 239 Street Yard (for reverse direction operation to/from Wakefield - 241 Street); and
- 240 Street Yard (for reverse direction operation to/from Van Cortlandt Park - 242 Street).

At the two loop terminals (Bowling Green and Brooklyn Bridge - City Hall), no explicit turn time is required as the train continues in the same direction. At Battery Park Loop (Bowling Green), 5 Line trains often wait on the loop until their prescribed slot becomes available, between successive 4 Line trains from Utica Avenue. At the City Hall Loop, 6 Line trains often wait for scheduled departure times of 6 Line trains ahead, departing northbound from the Brooklyn Bridge - City Hall station.

F.1.4.6 Routing

Routing, in terms of specific track assignments at each served station, is defined by the data in the RTIF files. The only exception to this is dynamic assignment of tracks at New Lots Avenue terminal, where the two station tracks are used in alternating order by turning trains. A similar dynamic routing situation exists at the Utica Avenue tail tracks and at Flatbush Avenue - Brooklyn College when the 5 Line service is not operating. During peak and midday time periods when both the 2 and 5 Lines serve Flatbush Avenue - Brooklyn College, Track 3 (the normally northbound track) is used exclusively by the 2 Line while Track 2 (the normally southbound track) is used exclusively by the 5 Line.

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A-Division operations in the Bronx feature a number of peak period-oriented operations and routing given the three-track nature of all five lines. For example, the complex “slot swapping” and merging operation of the 5 Line trains between 3 Avenue - 138 Street and the Lexington Avenue Line Harlem River Tubes is managed by having the southbound morning peak period 4 Line trains operate on the center track between 149 Street - Grand Concourse and 138 Street – Grand Concourse with the merge occurring south of 138 Street - Grand Concourse. In the northbound morning peak period, all 4 Line and 5 Line trains use the local track through 138 Street - Grand Concourse. The evening patterns are reversed with the center track between the diverge just south of 138 Street - Grand Concourse and 149 Street - Grand Concourse used by all 4 Line trains, bypassing the 138 Street - Grand Concourse station.

Except for the 4 Line operation at 138 Street - Grand Concourse, the center track is not normally used for scheduled revenue movements. Similarly, the center tracks of the Broadway and Dyre Avenue Lines in the Bronx are not normally used for revenue service.

F.1.4.7 Schedule Margin and Braking Comfort Factors

Simulation schedule margin is an overall derating of acceleration, maximum operating speed and deceleration, as well as adjustment of dwell. Schedule margin is typically in the 5 to 15 percent range. Schedule margin has the effect of adding a specified percentage to simulated station-to-station travel time versus the “all out” or “golden run” simulation. For example, 5 percent schedule margin would cause a 100 second “golden run” between stations to be simulated with a travel time of 105 seconds. A 5 percent schedule margin was applied to all lines as part of the calibration process.

Both the R62/62A and R142/142A vehicle models feature a design brake rate of 3 MPHPS. The braking effort curve of both vehicles provides adequate braking effort at all speeds to achieve this brake rate at the AW2 passenger load used in the simulation. However, the simulated brake rate was reduced as part of the calibration process, first by the 5 percent schedule margin and second by braking comfort factors.

TrainOps® braking comfort factors are a way of derating train performance beyond schedule margin. In order to enforce a comfortable braking rate for passengers and to achieve a “best fit” with the event recorder data, all trips are limited to 60% of the available braking effort for station stops, for civil speed restrictions and for approaching signals at stop.

In simulation, brake rates vary between stops due to differing grade, curve, weight, and air resistance. Overall, the simulated braking rates were in the 1.4 to 1.6 MPHPS range, typical for rapid transit operations but significantly below the 3.0 MPHPS deceleration capability of the A-Division fleet.

F.1.4.8 Operating Variability

Operating variability was applied to train put-ins at the boundaries of the combined Phase I and Phase II simulation model. This variability reflected existing manual train operation and significant differences in trip-by-trip performance. Variability was applied to the following locations:

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- Nevins Street southbound – 2 and 3 Lines;
- 149 Street - Grand Concourse (UL) southbound – 4 Line;
- 149 Street - Grand Concourse (LL) southbound – 5 Line; and
- 3 Avenue - 138 Street southbound – 6 Line.

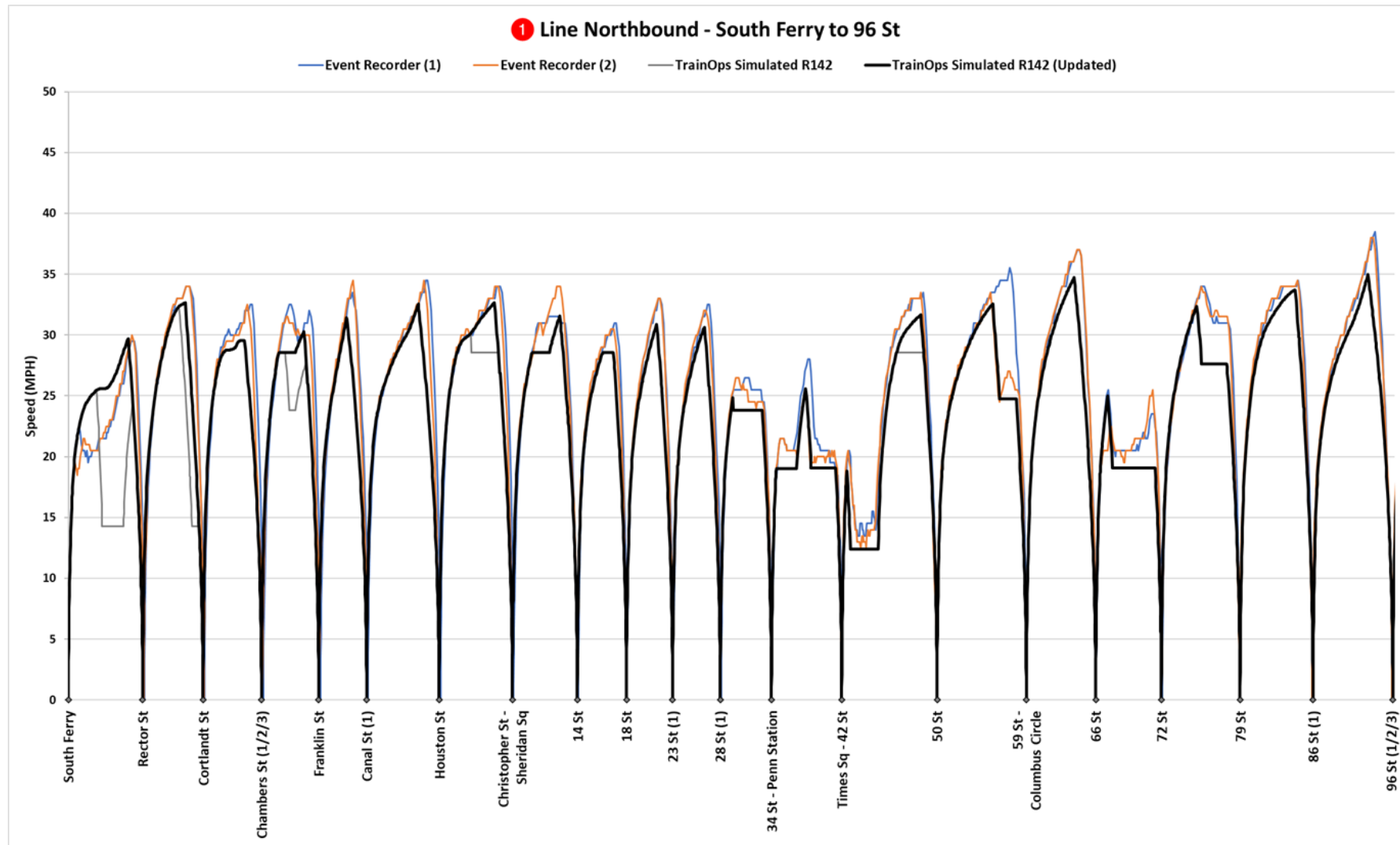
As the Phases I-IV model simulates the full network, applying operating variability to train put-ins at the above locations is no longer necessary and has been removed.

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**F.2 Train Event Recorder Data and Corresponding TrainOps® Velocity versus
Distance Plots**

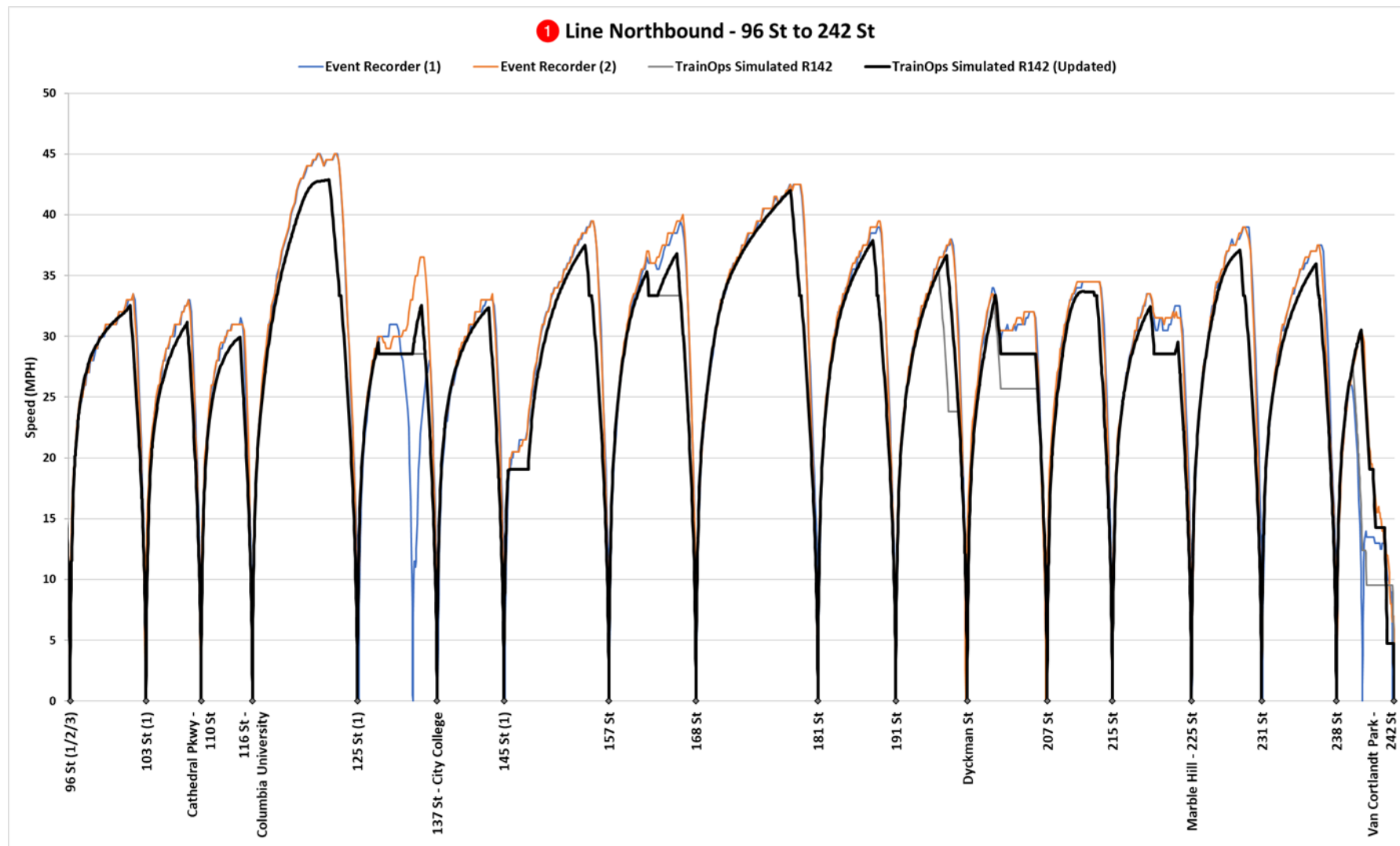
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Figure F.2-1. 1 Line Northbound, South Ferry to 96 Street



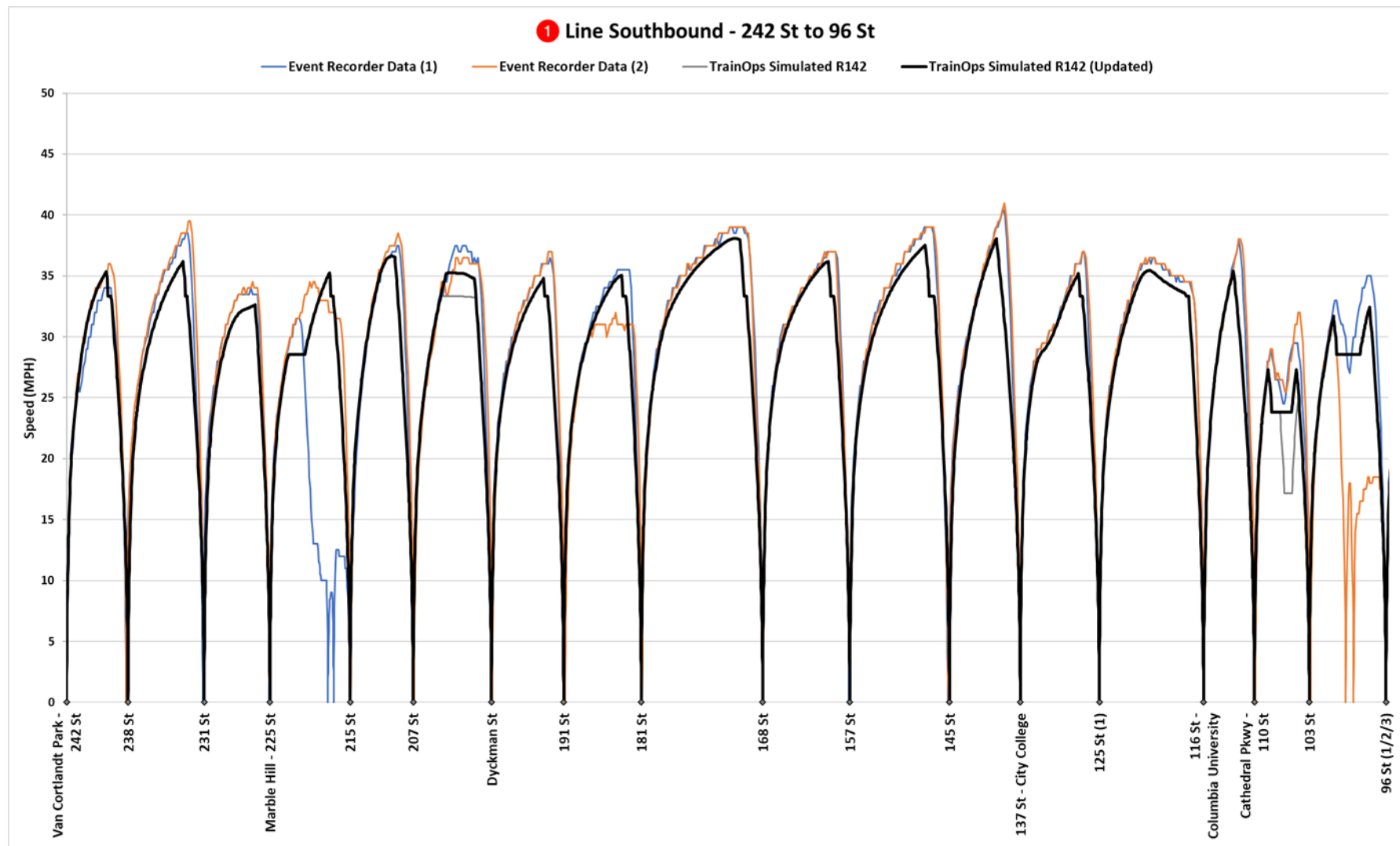
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Figure F.2-2. ① Line Northbound, 96 Street to Van Cortlandt Park - 242 Street



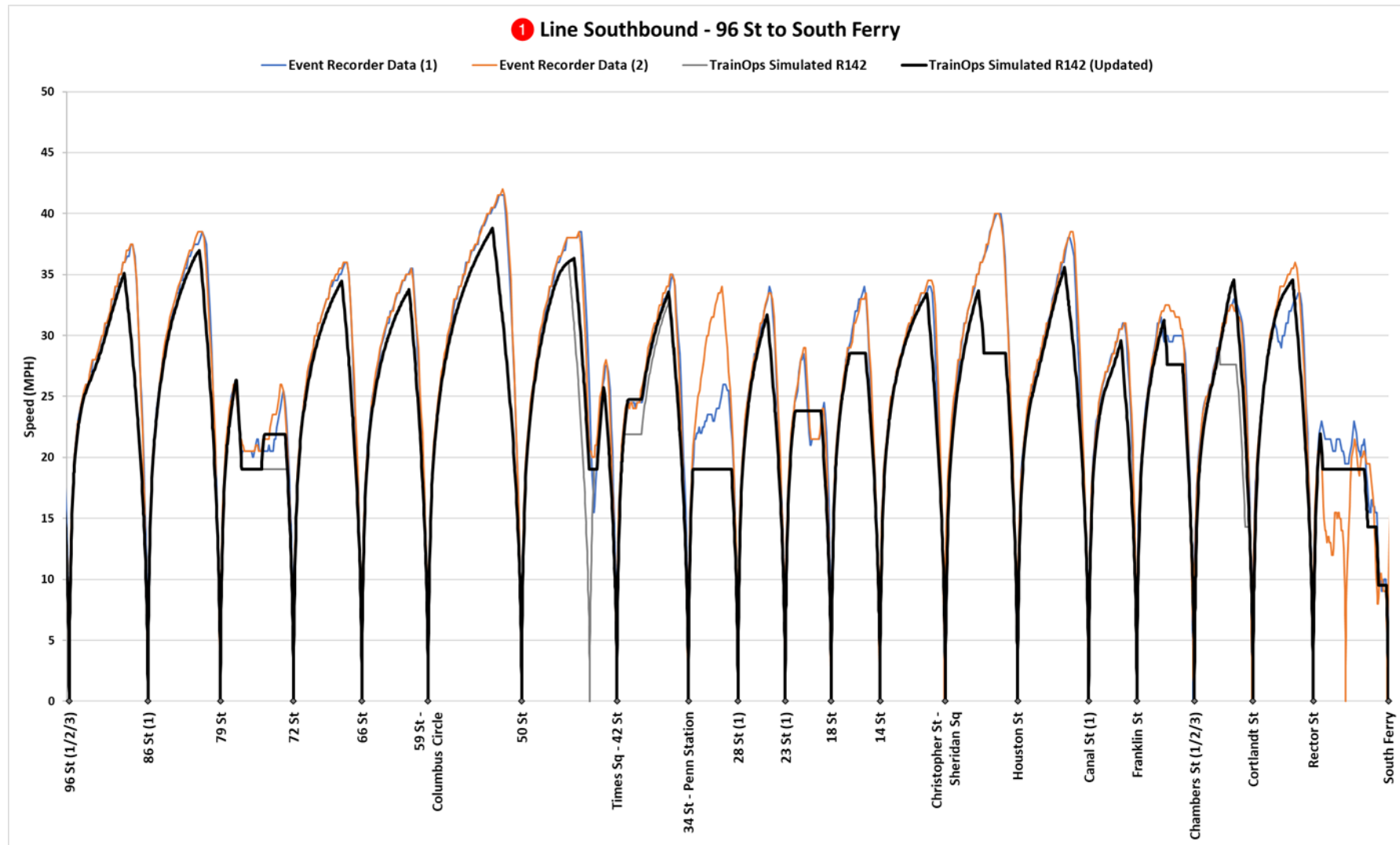
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Figure F.2-3. ① Line Southbound, Van Cortlandt Park - 242 Street to 96 Street



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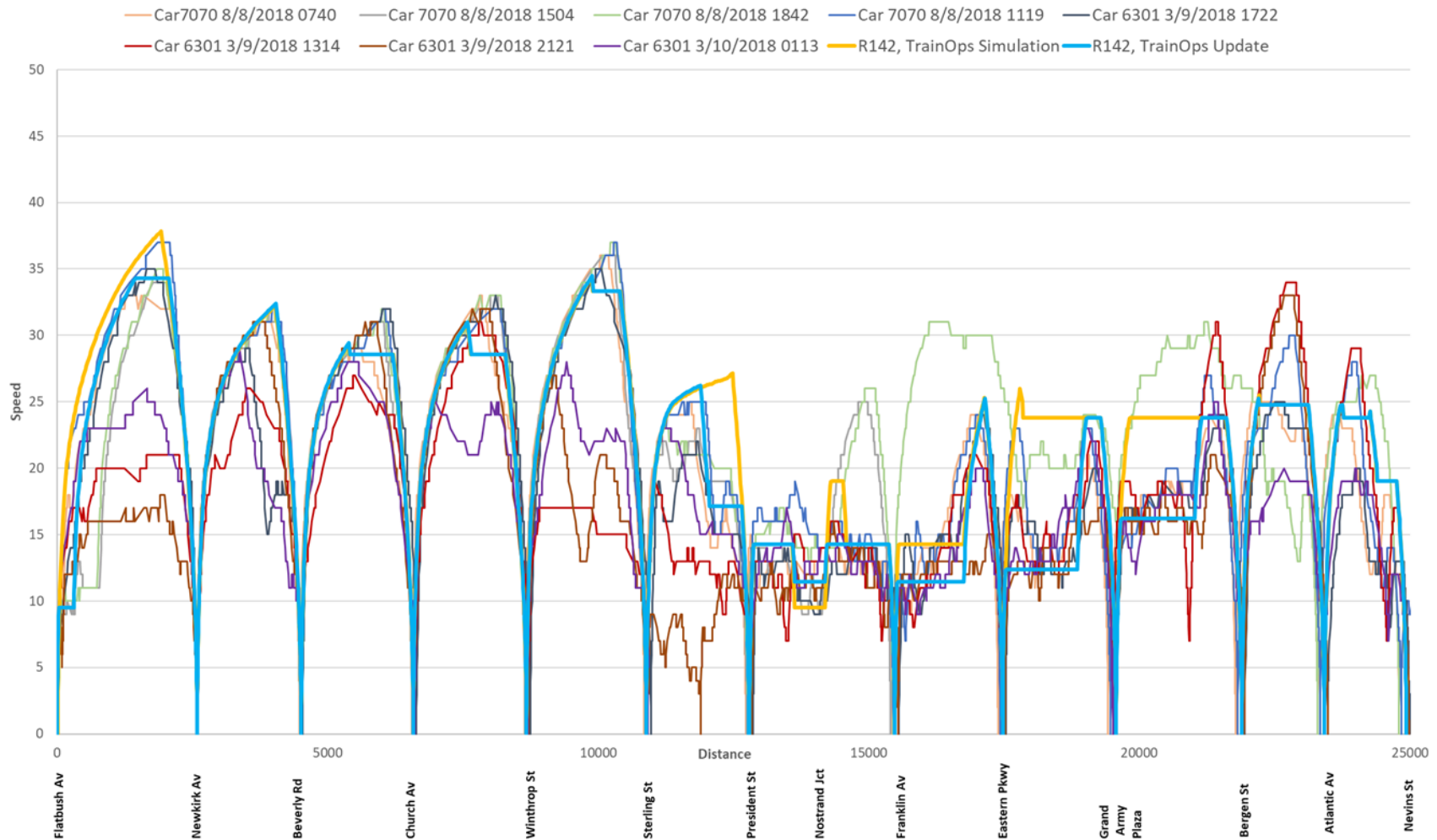
Figure F.2-4. 1 Line Southbound, 96 Street to South Ferry



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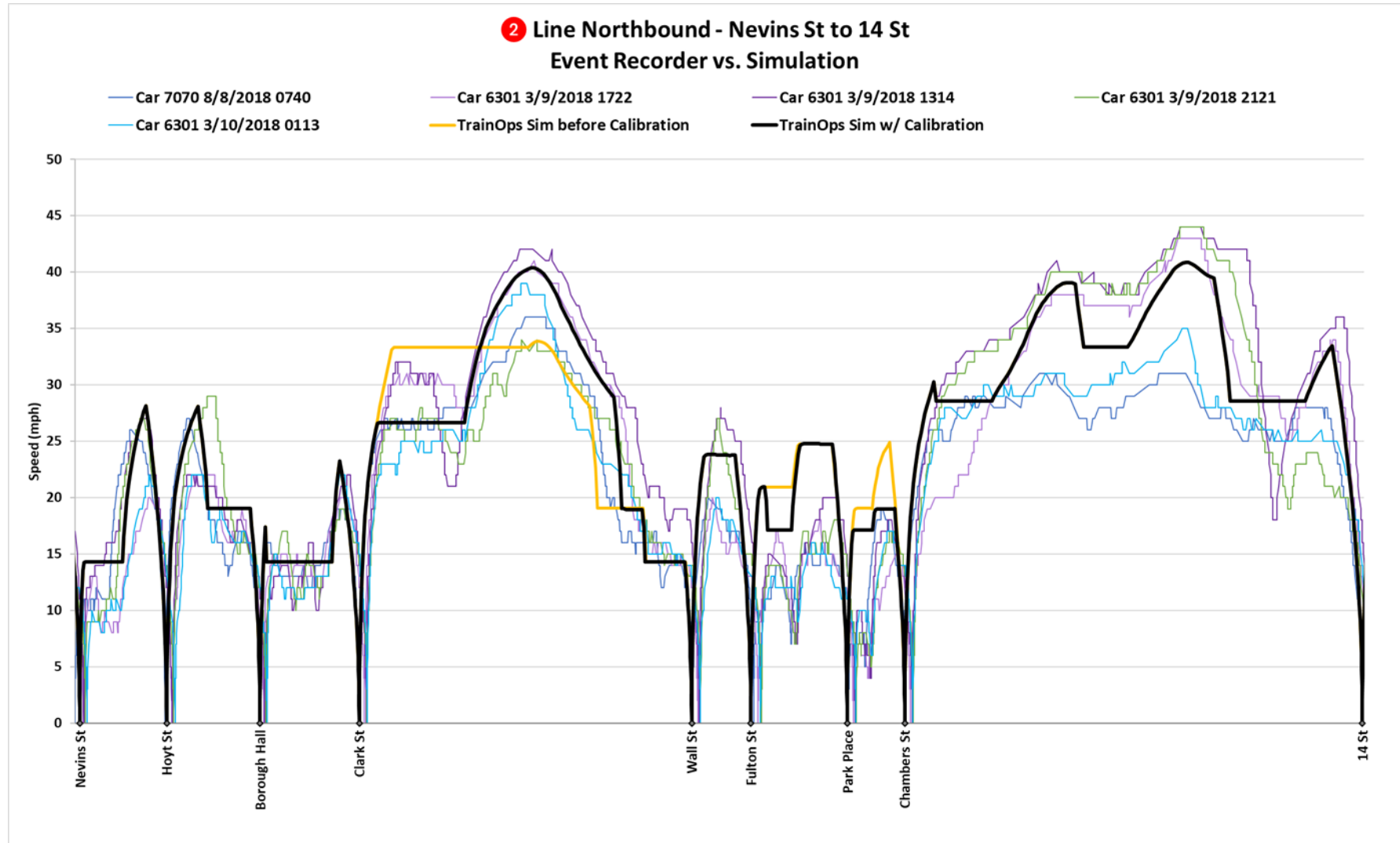
Figure F.2-5. ② Line Northbound, Flatbush Avenue – Brooklyn College to Nevins Street

② Line Northbound - Flatbush Av to Nevins St



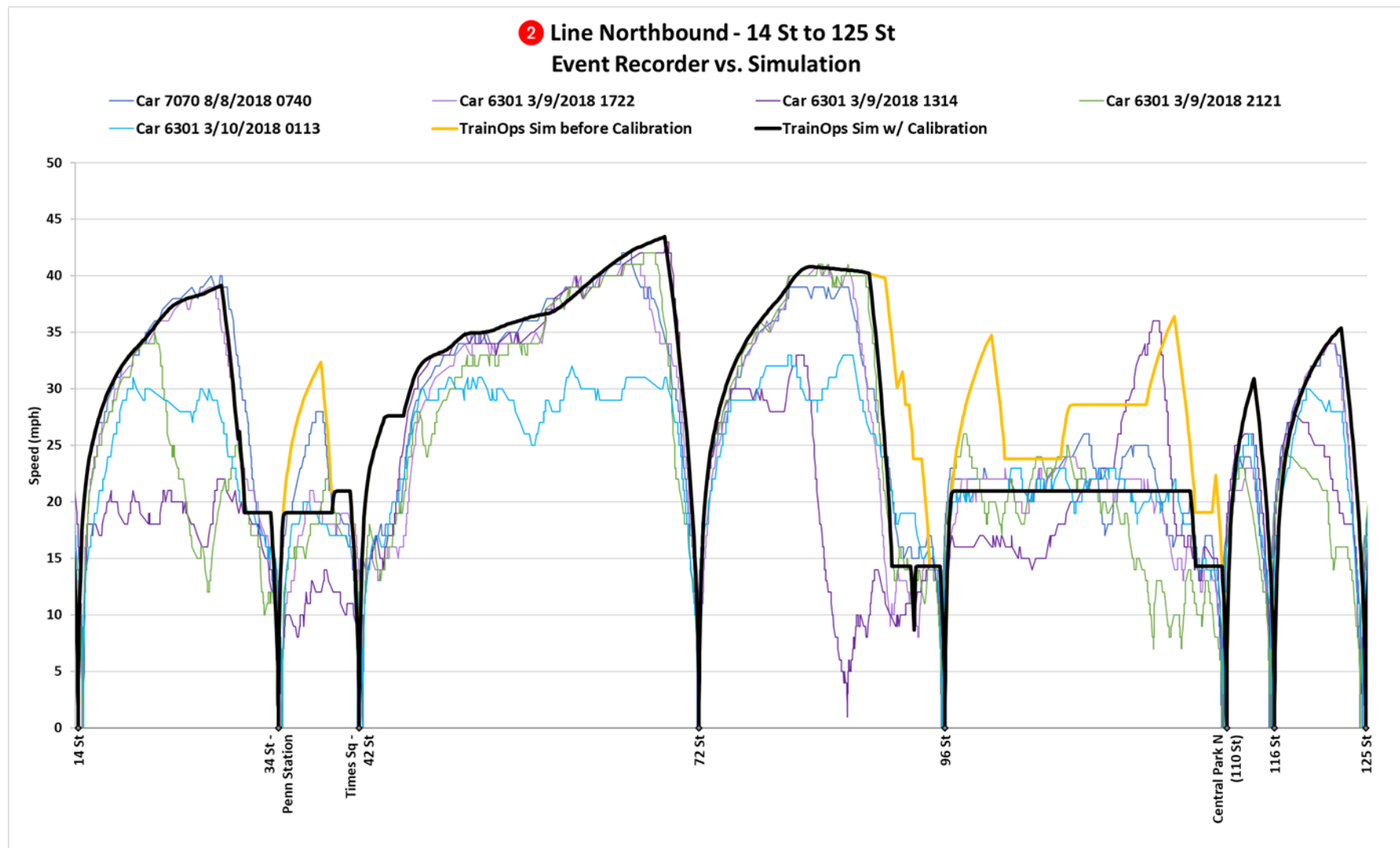
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Figure F.2-6. ② Line Northbound, Nevins Street to 14 Street



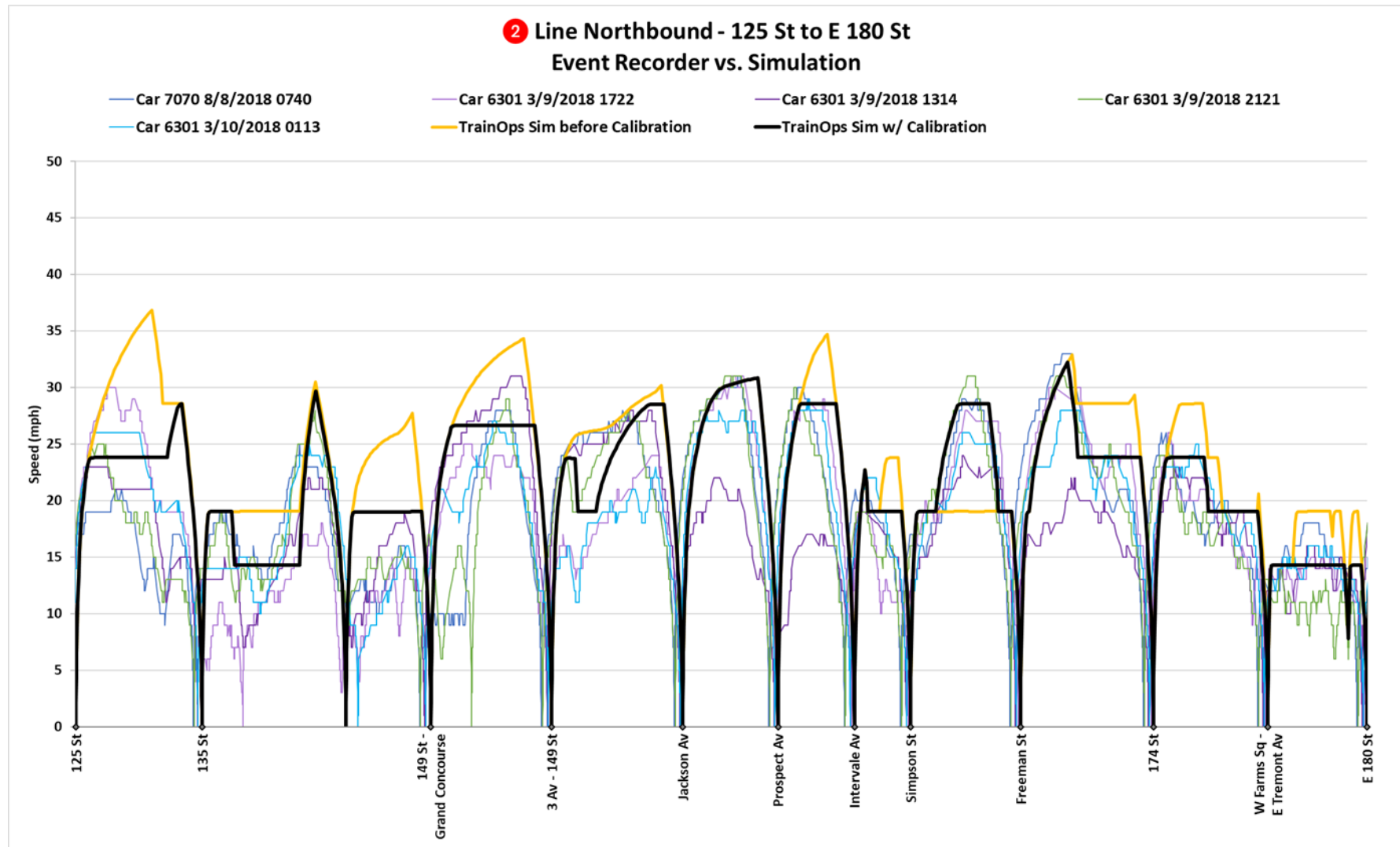
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Figure F.2-7. ② Line Northbound, 14 Street to 125 Street



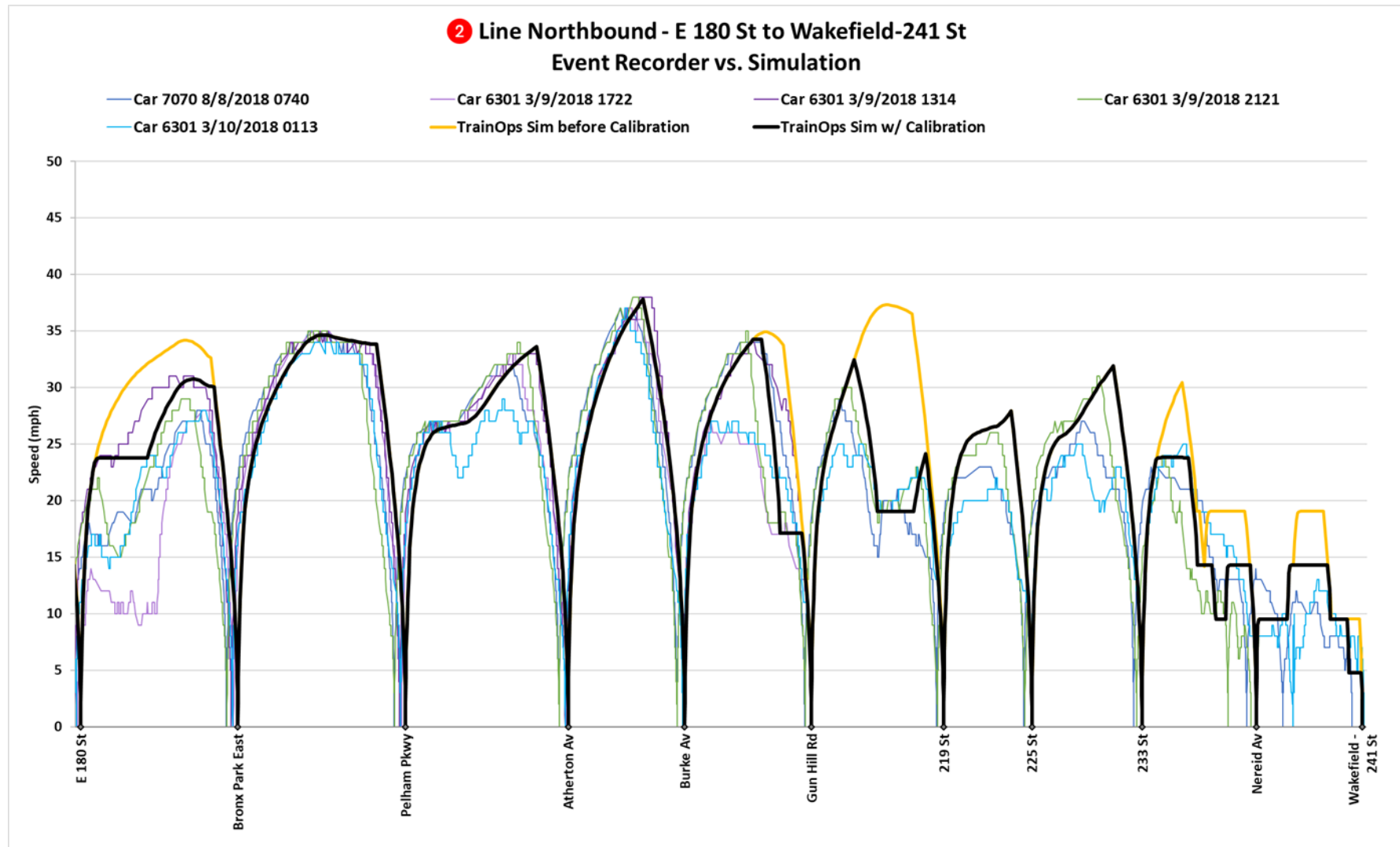
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Figure F.2-8. ② Line Northbound, 125 Street to East 180 Street



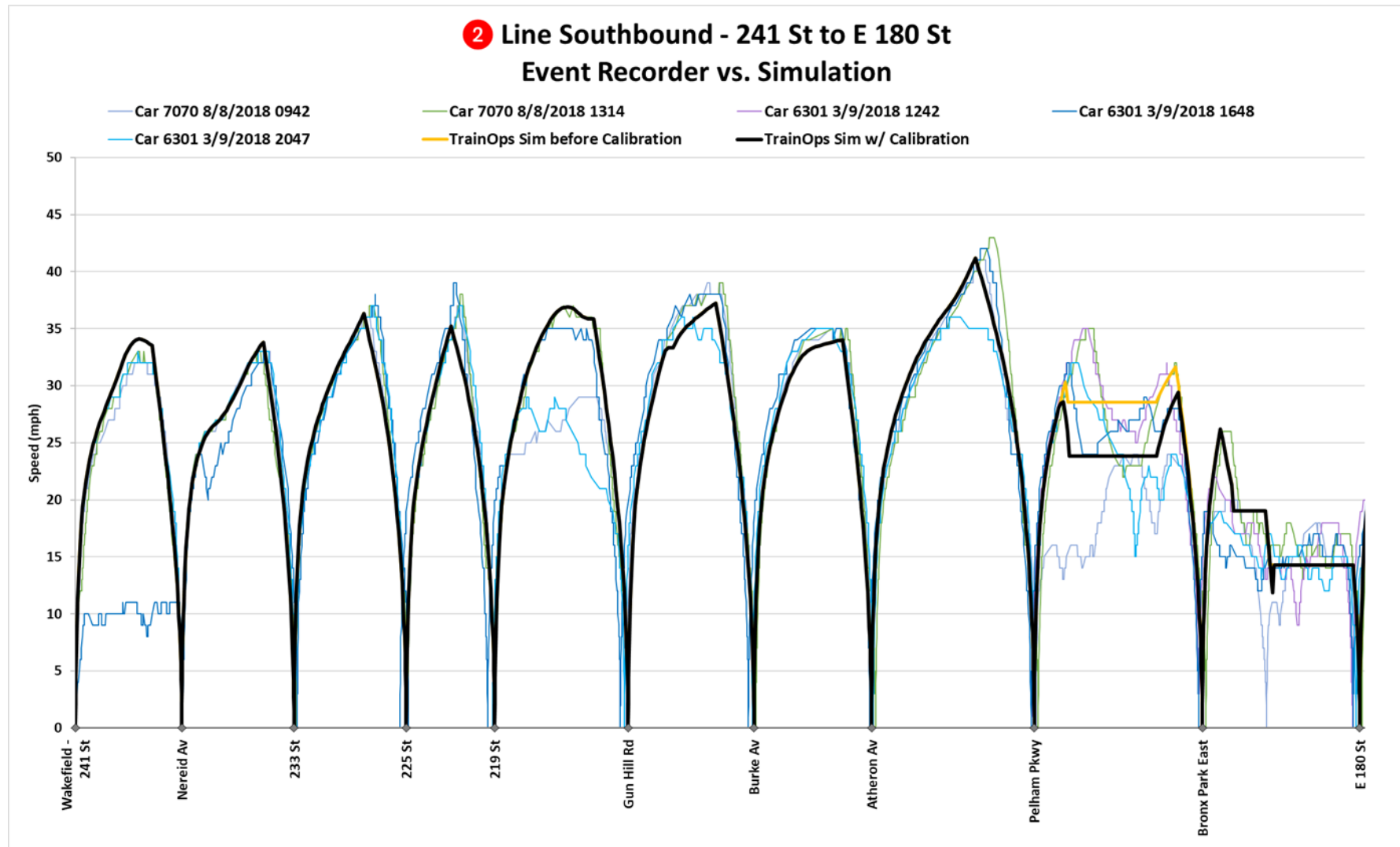
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Figure F.2-9. 2 Line Northbound, East 180 Street to Wakefield – 241 Street



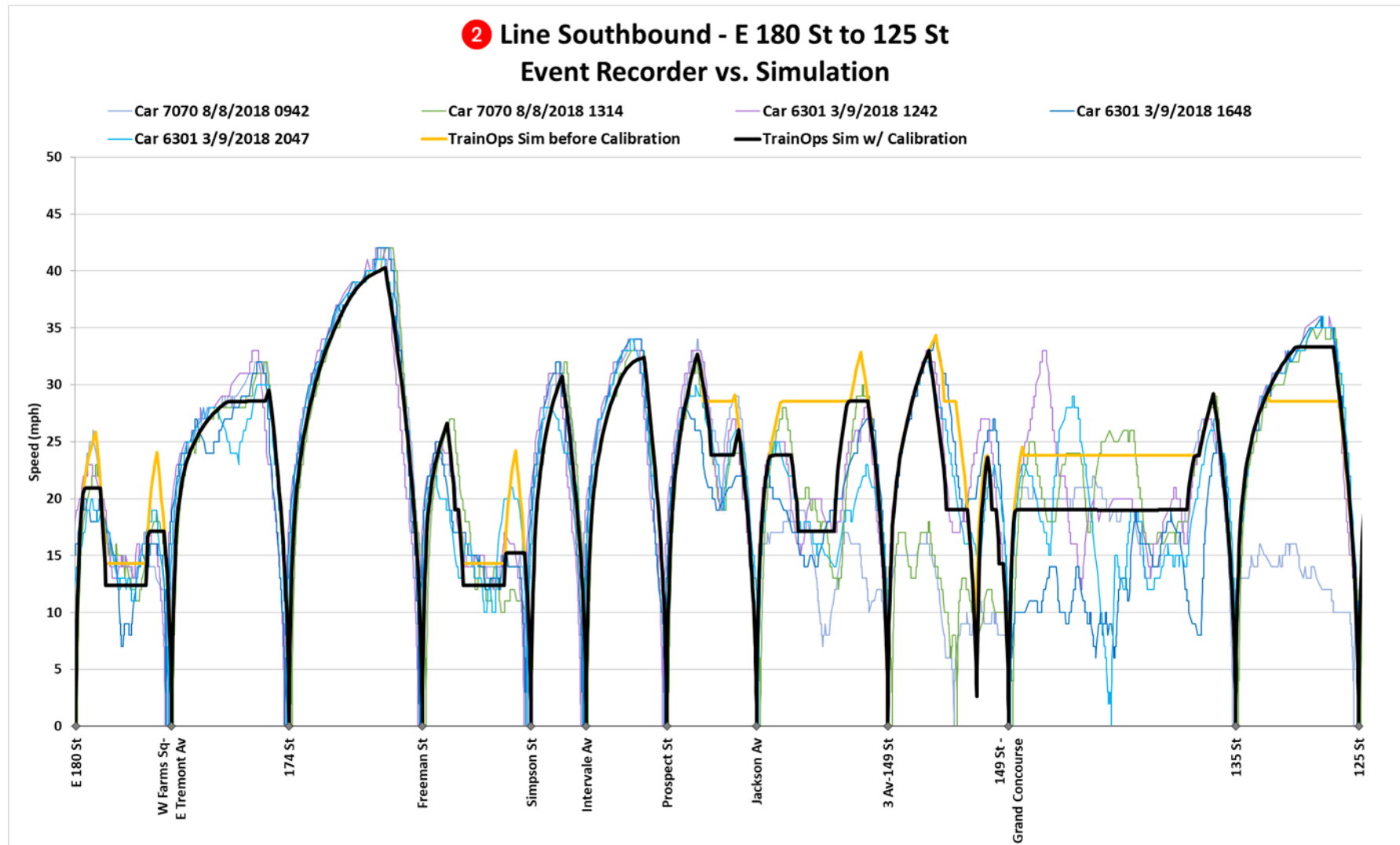
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Figure F.2-10. ② Line Southbound, Wakefield – 241 Street to East 180 Street



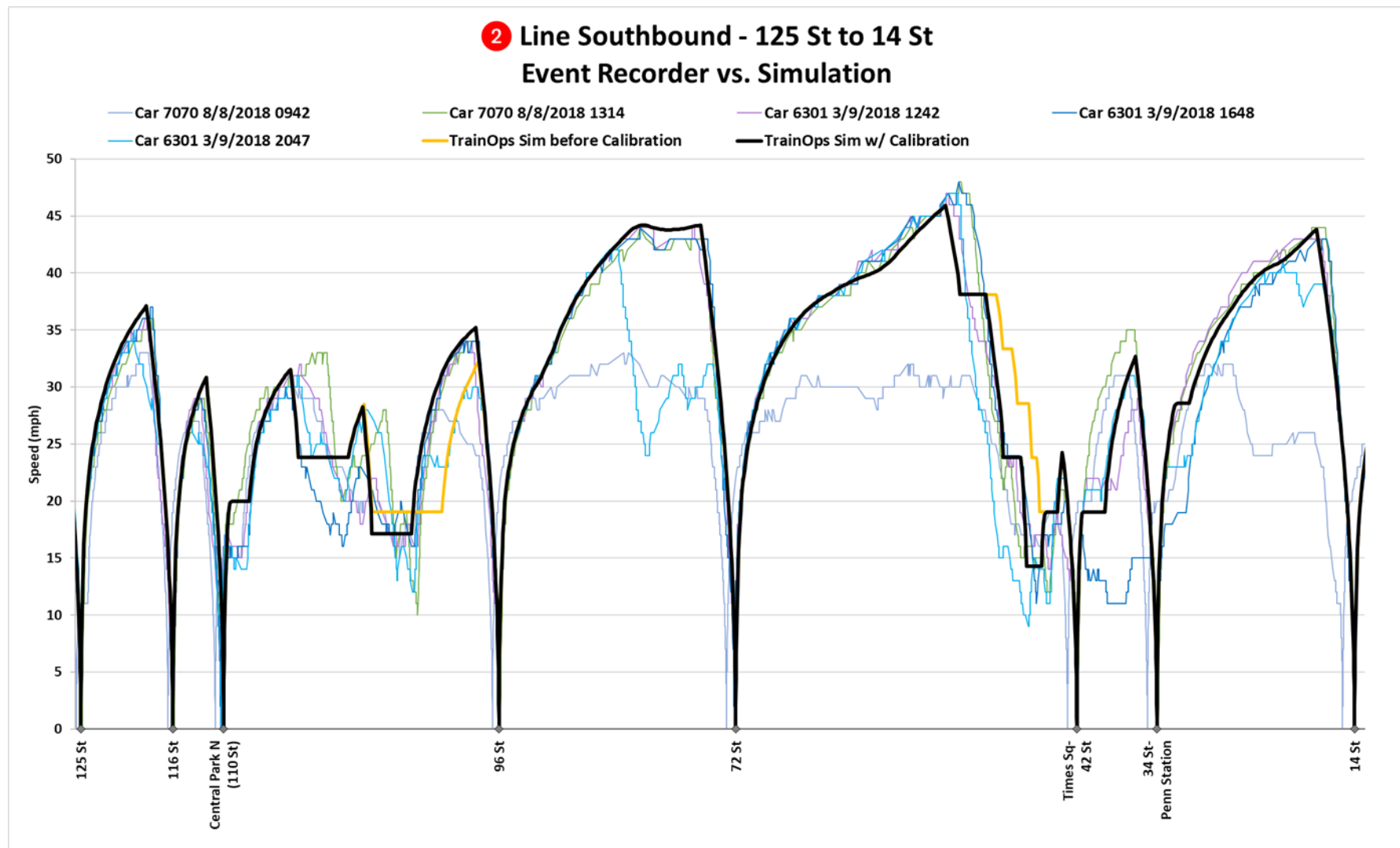
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Figure F.2-11. ② Line Southbound, East 180 Street to 125 Street



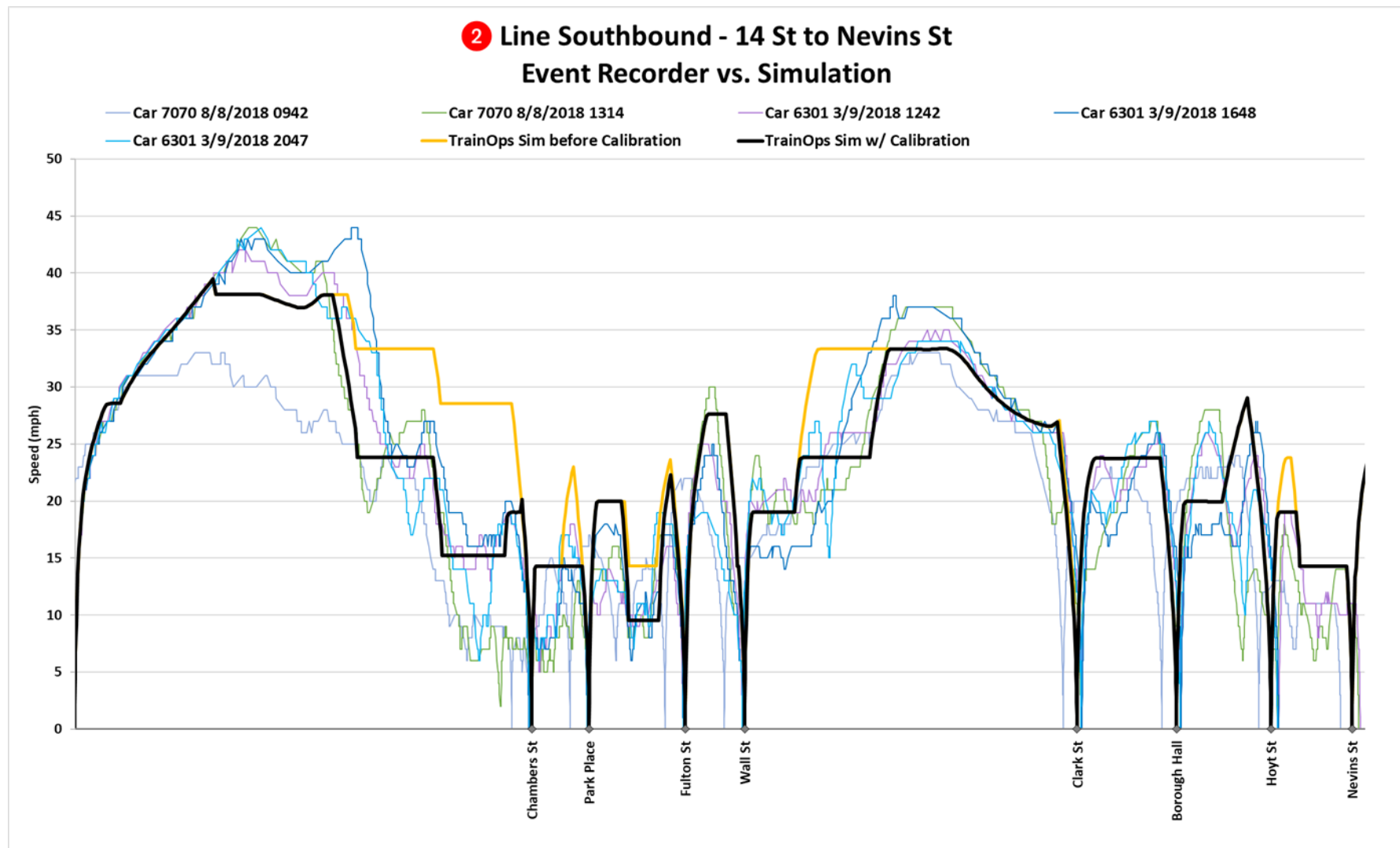
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Figure F.2-12. 2 Line Southbound, 125 Street to 14 Street



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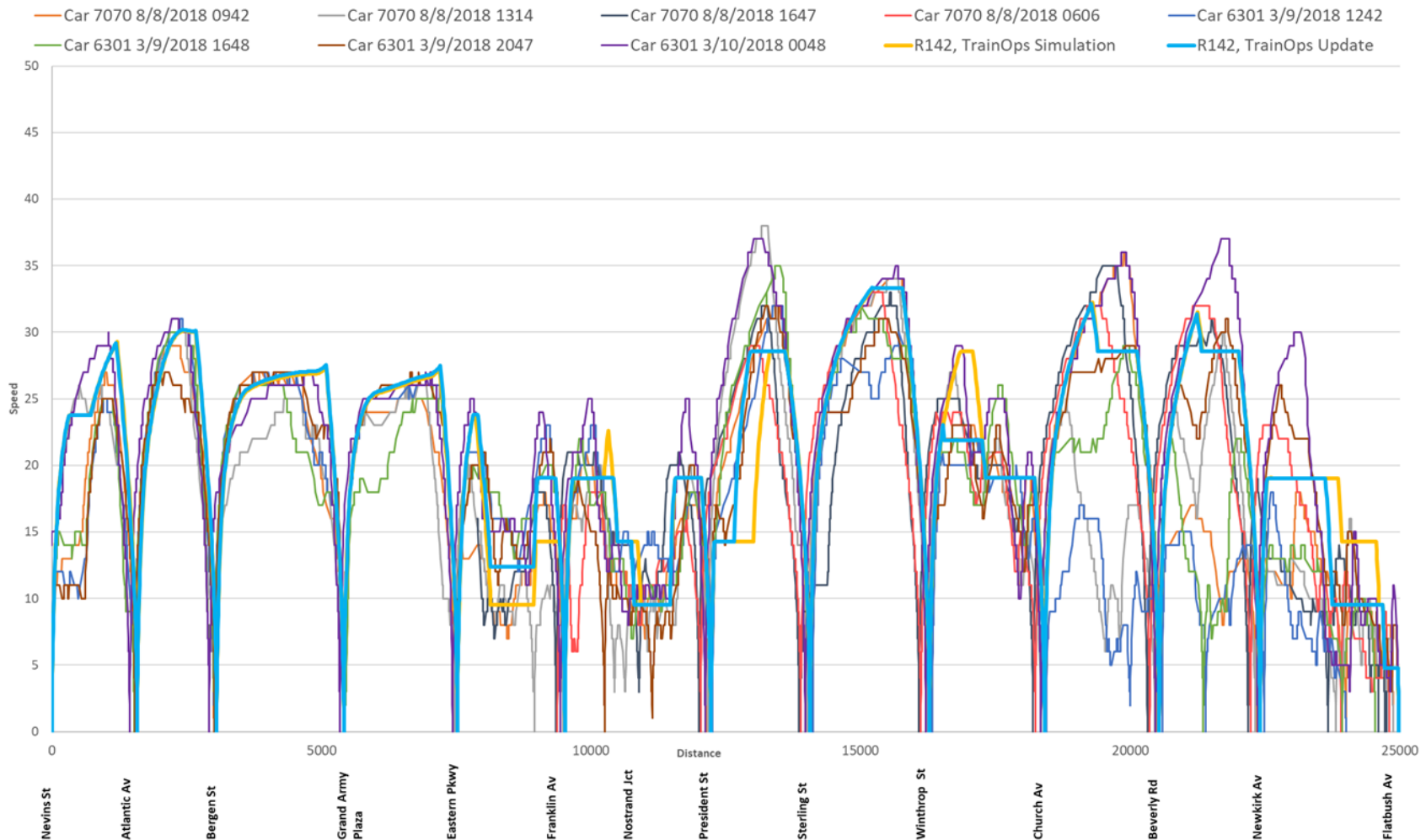
Figure F.2-13. ② Line Southbound, 14 Street to Nevins Street



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Figure F.2-14. 2 Line Southbound, Nevins Street to Flatbush Avenue – Brooklyn College

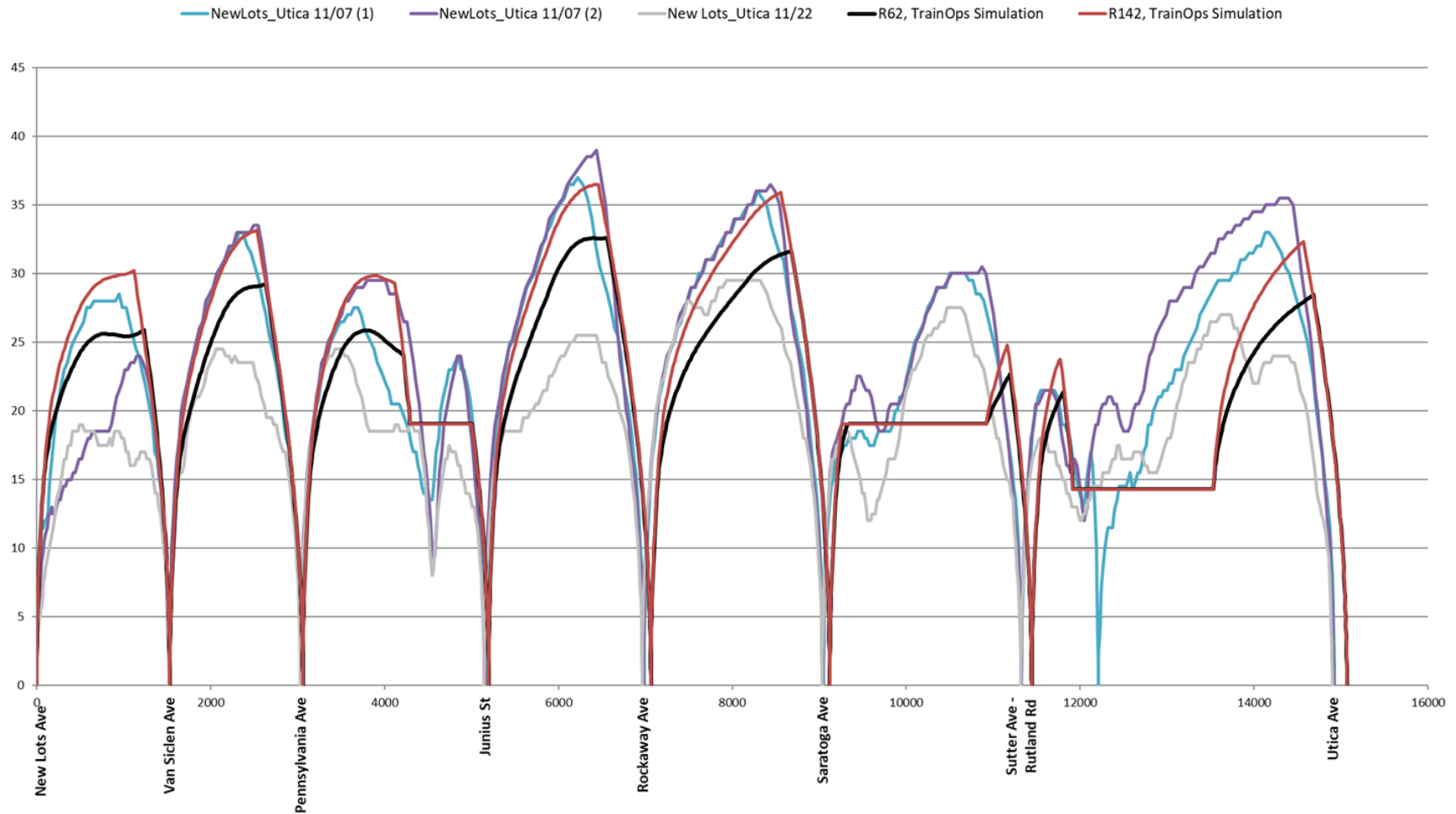
2 Line Southbound - Nevins St to Flatbush Av



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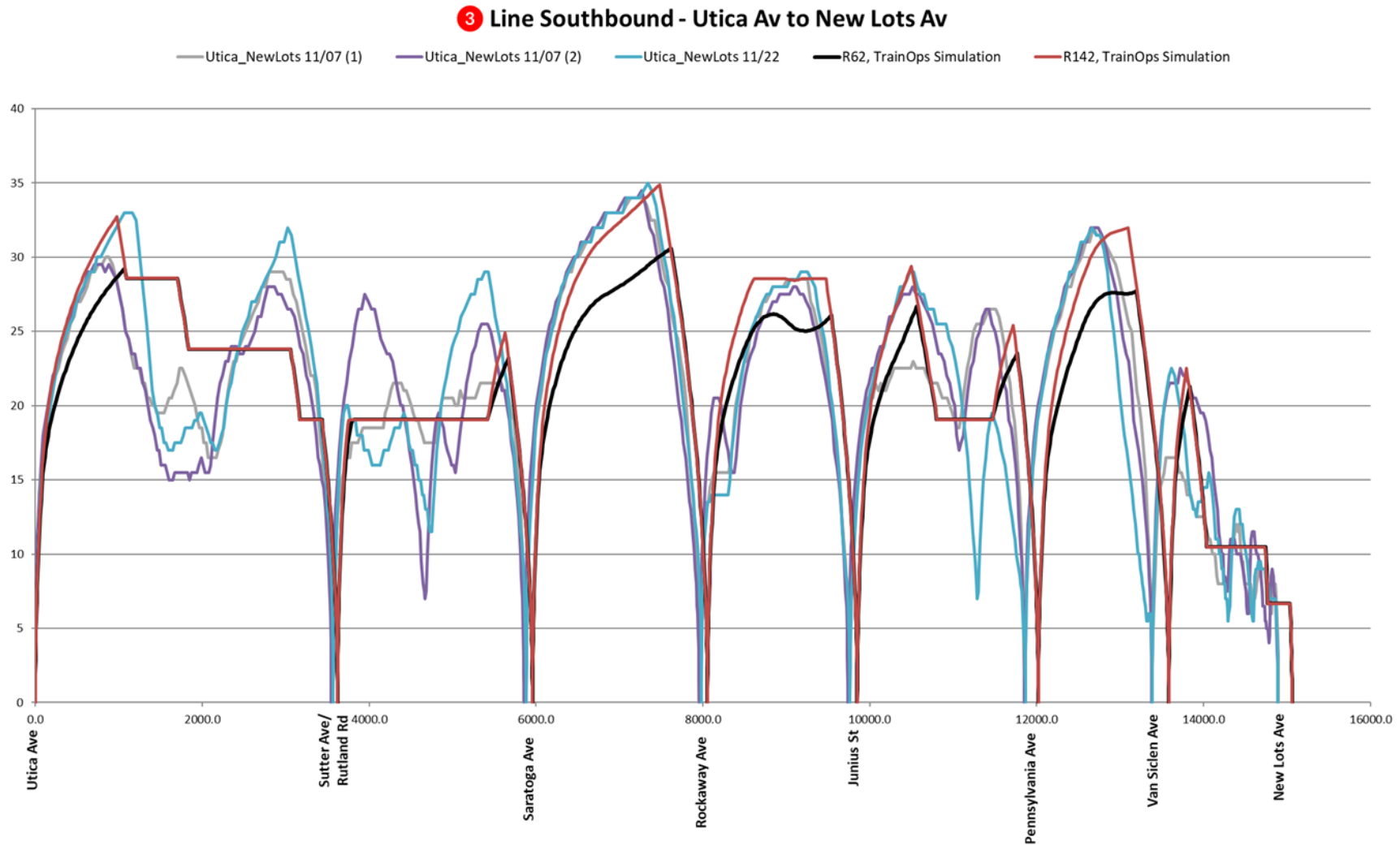
Figure F.2-15. ③ Line Northbound, New Lots Avenue to Crown Heights – Utica Avenue

③ Line Northbound - New Lots Ave to Utica Ave



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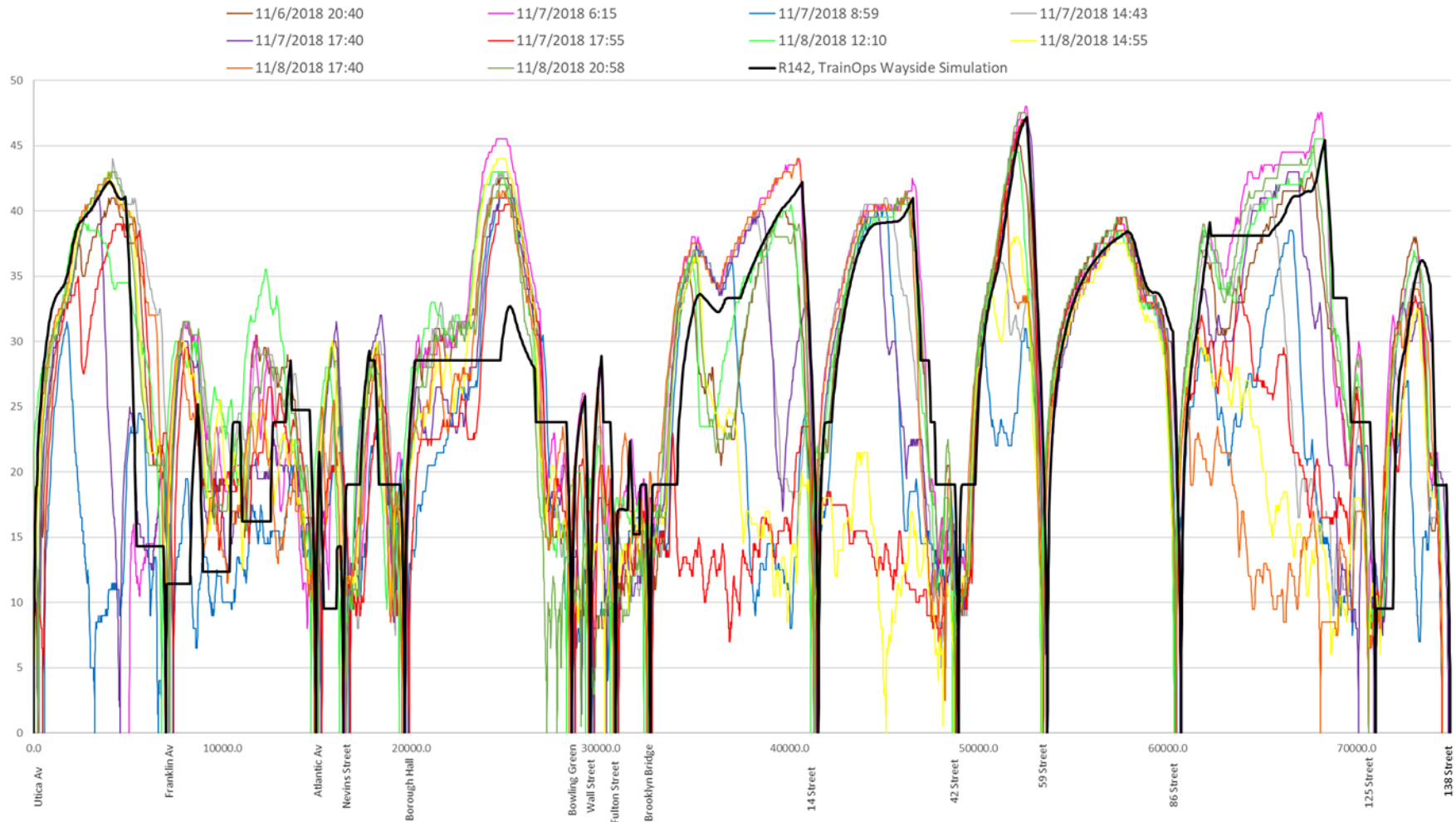
Figure F.2-16. ③ Line Southbound, Crown Heights – Utica Avenue to New Lots Avenue



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Figure F.2-17. 4 Line Northbound, Crown Heights – Utica Avenue to 138 Street – Grand Concourse

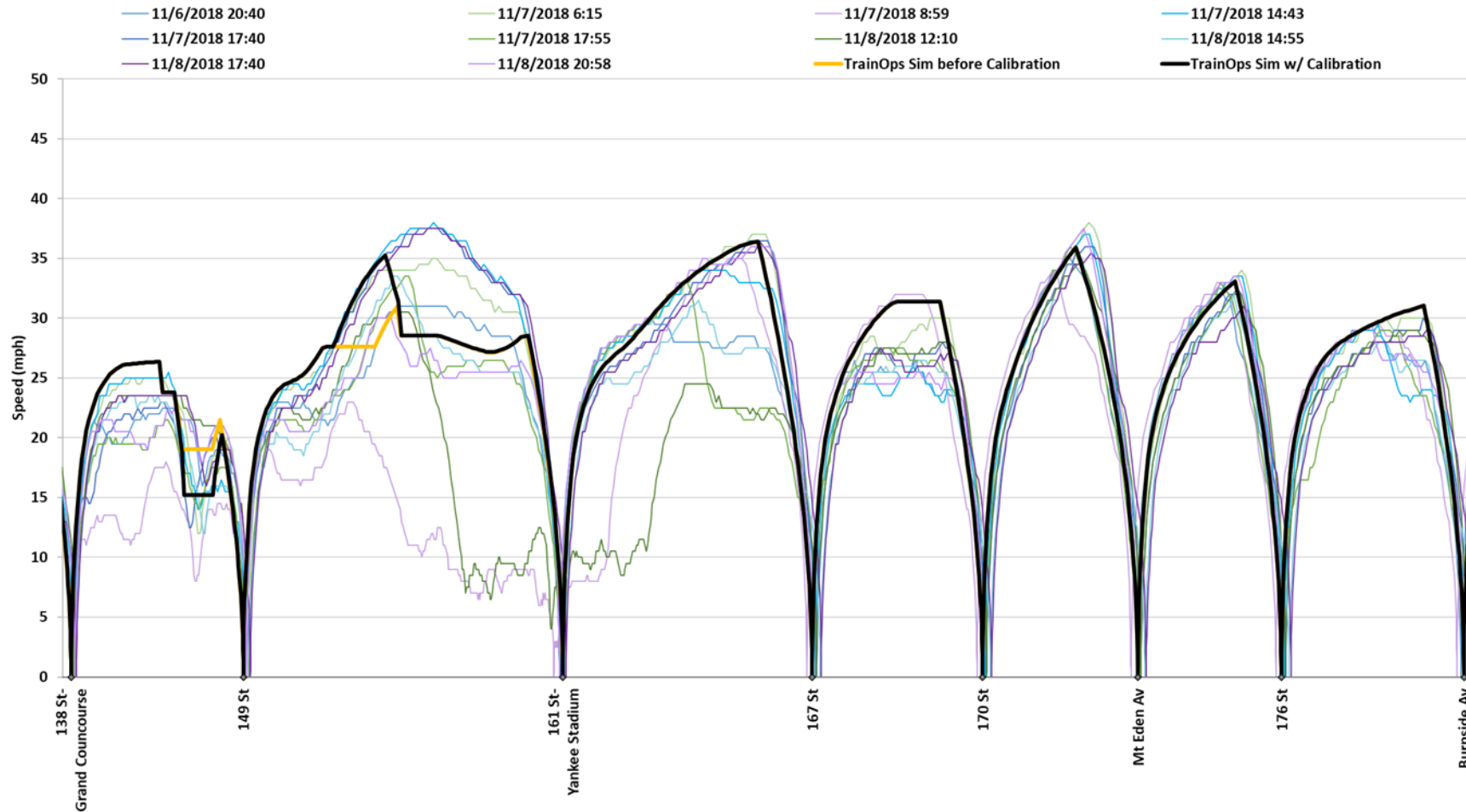
4 Line Northbound - Utica Av to 138 St-Grand Concourse



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Figure F.2-18. ④ Line Northbound, 138 Street – Grand Concourse to Burnside Avenue

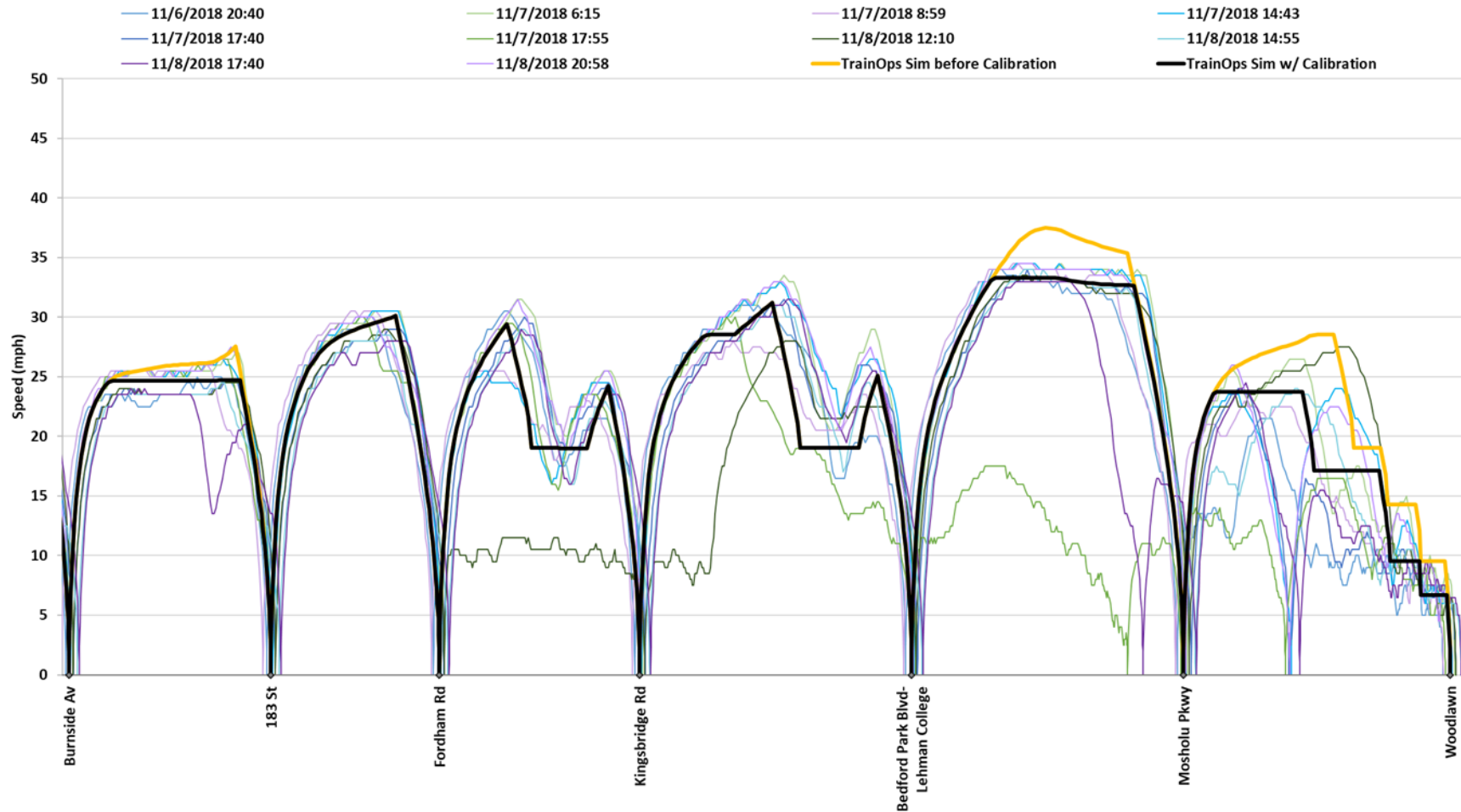
④ Line Northbound - 138 St-Grand Concourse to Burnside Av Event Recorder vs. Simulation



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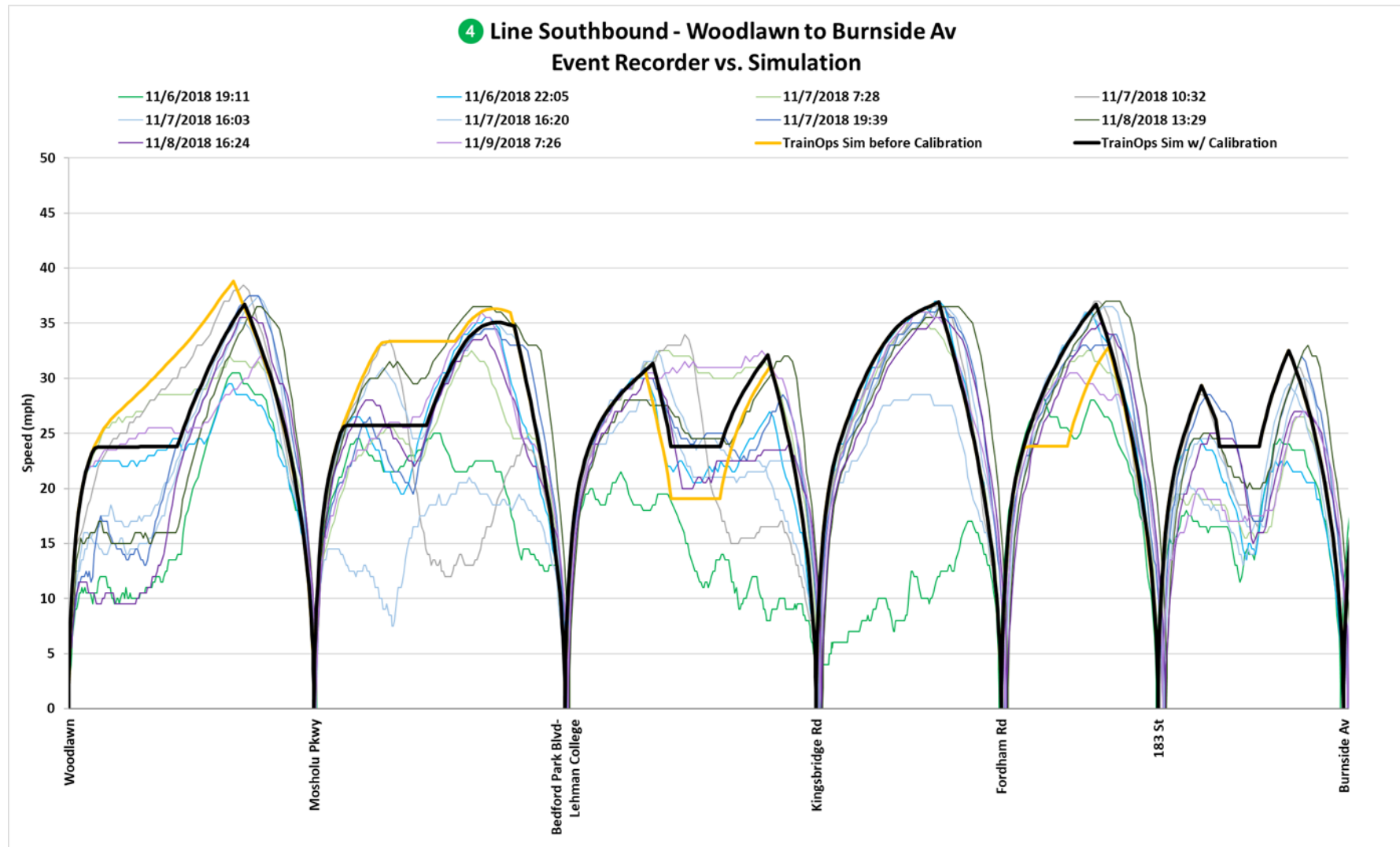
Figure F.2-19. 4 Line Northbound, Burnside Avenue to Woodlawn

4 Line Northbound - Burnside Av to Woodlawn Event Recorder vs. Simulation



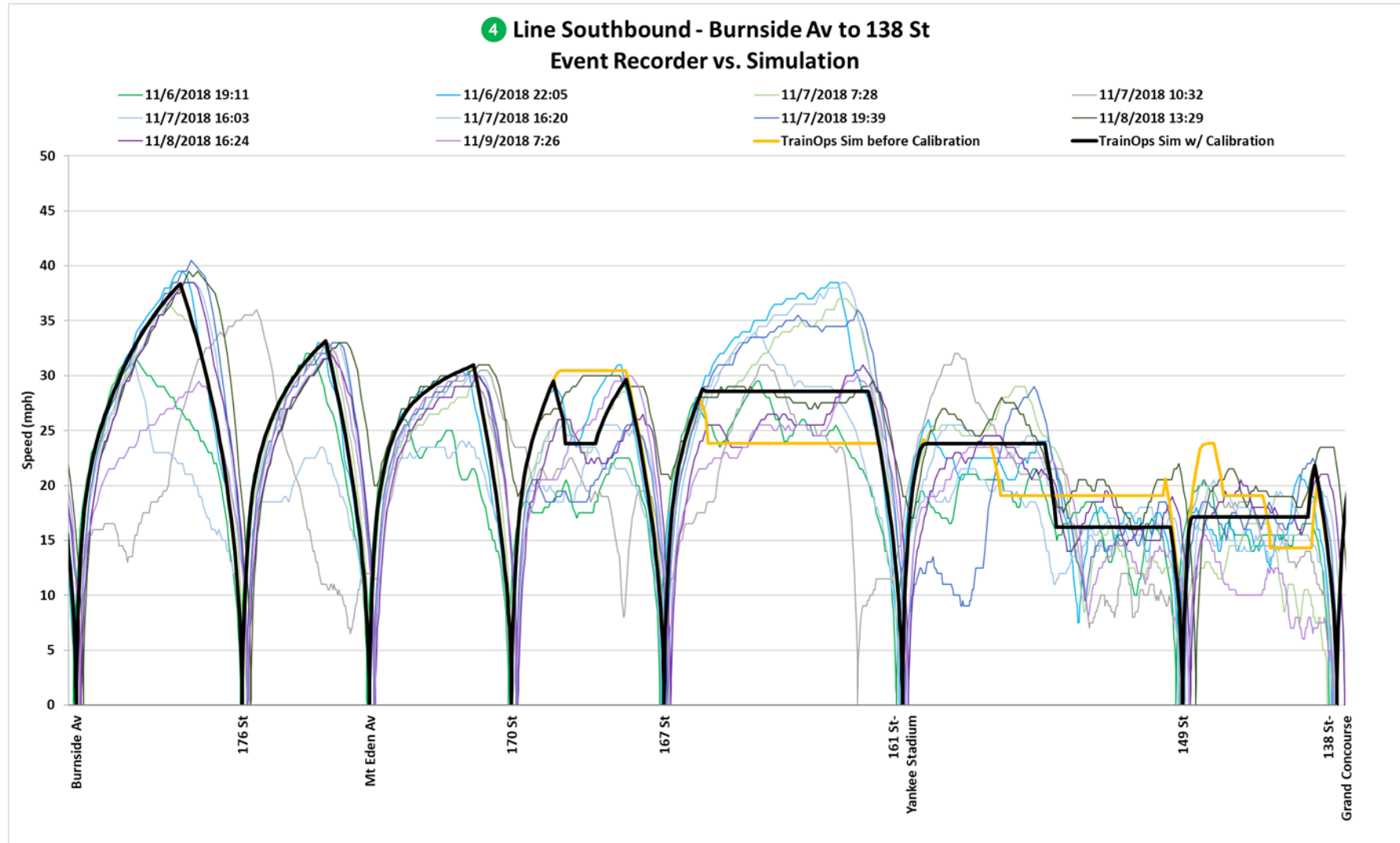
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Figure F.2-20. ④ Line Southbound, Woodlawn to Burnside Avenue



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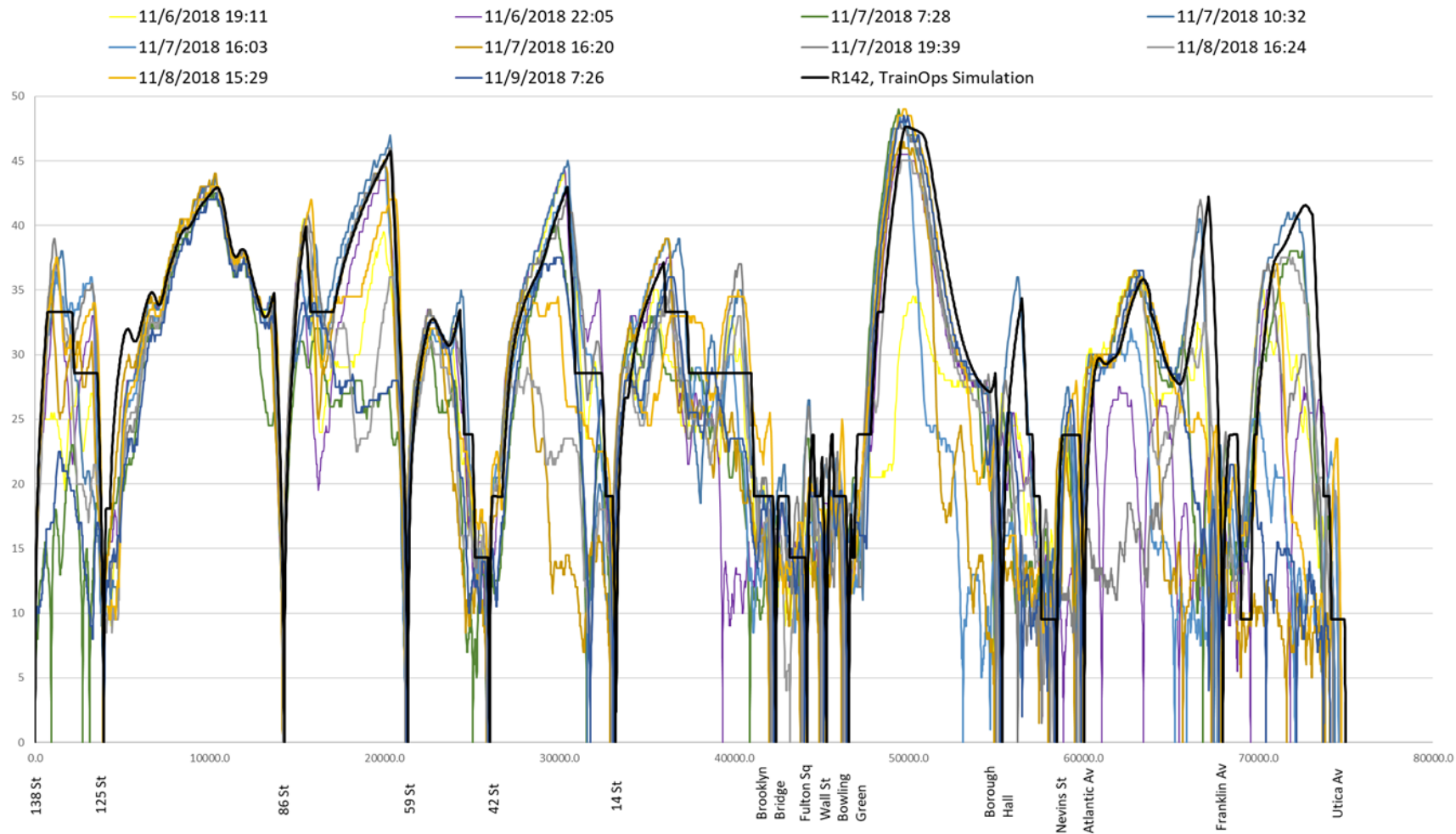
Figure F.2-21. ④ Line Southbound, Burnside Avenue to 138 Street - Grand Concourse



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Figure F.2-22. 4 Line Southbound, 138 Street – Grand Concourse to Crown Heights – Utica Avenue

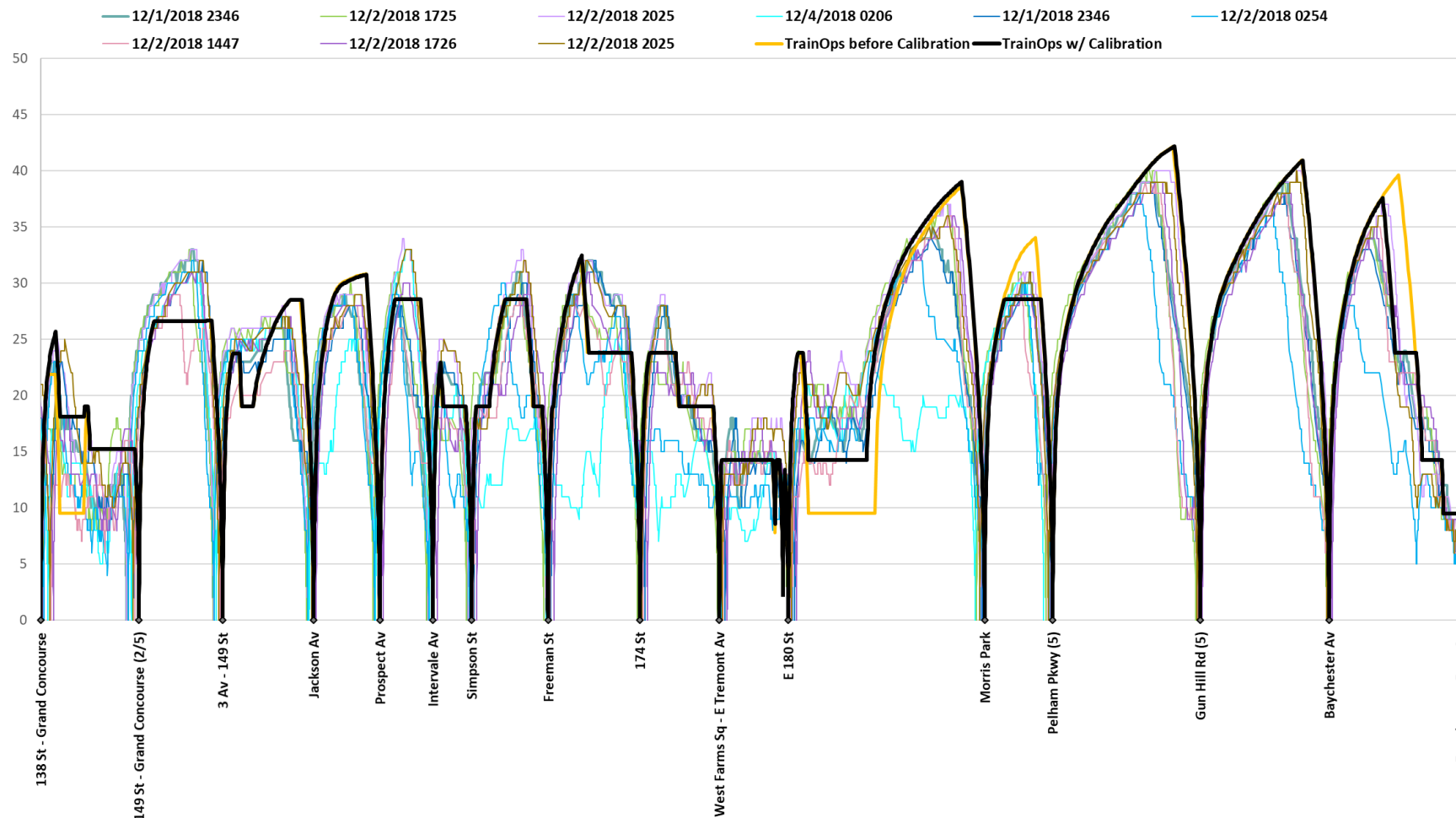
4 Line Southbound - 138 St-Grand Concourse to Utica Av



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Figure F.2-23. 5 Line Northbound, 138 Street – Grand Concourse to Eastchester – Dyre Avenue

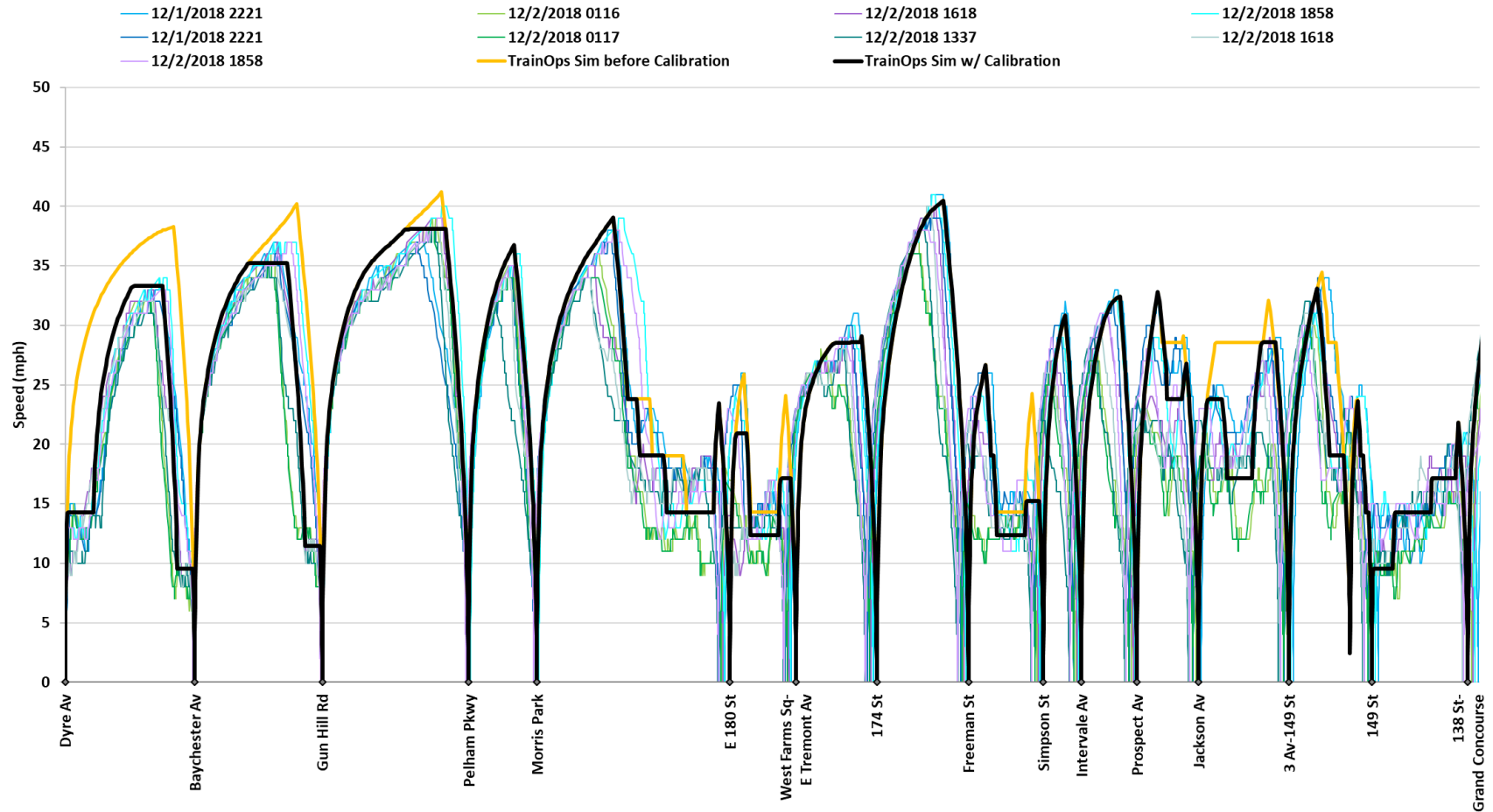
5 Line Northbound - 138 St-Grand Concourse to Dyre Av Event Recorder vs. Simulation



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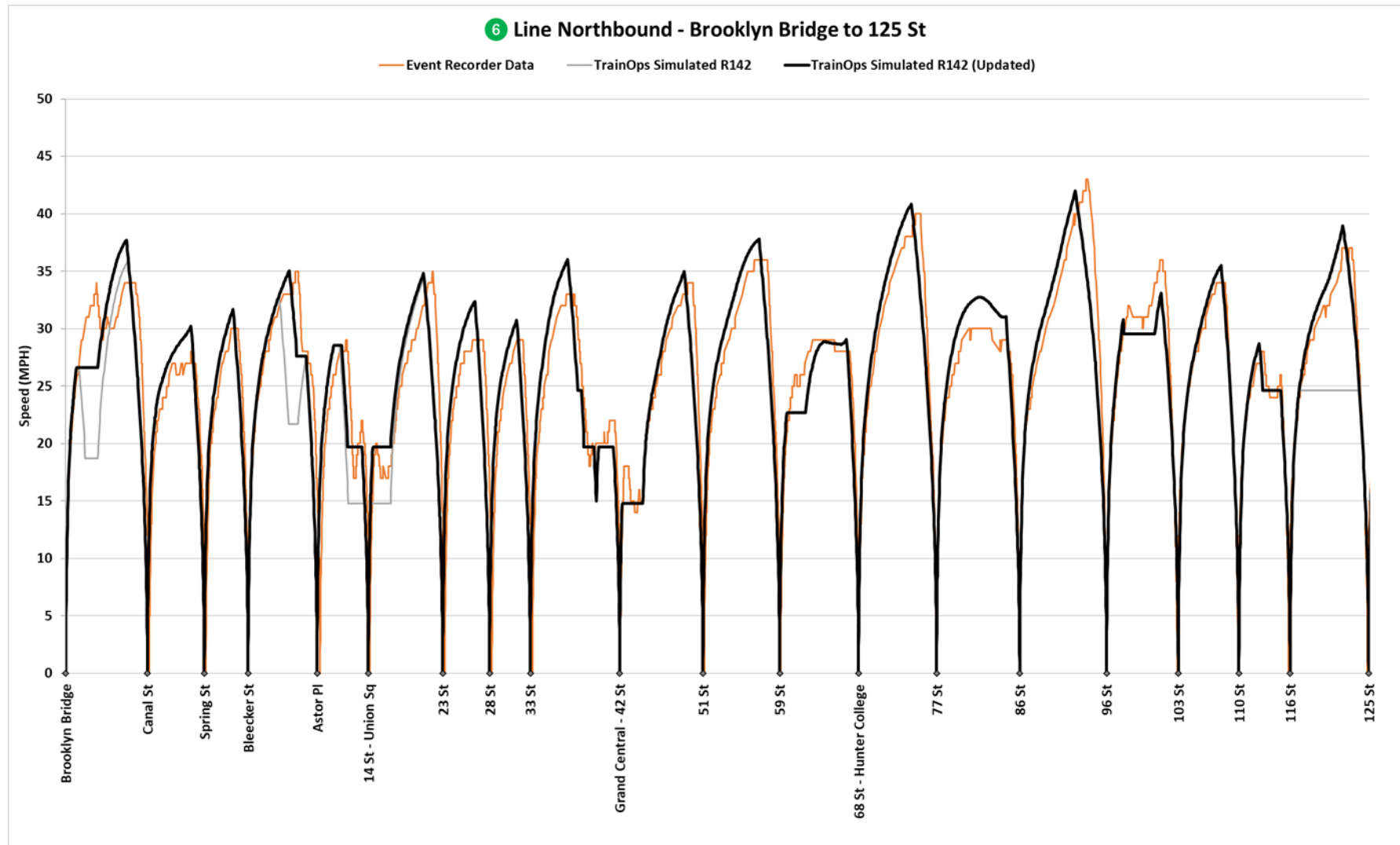
Figure F.2-24. 5 Line Southbound, Eastchester – Dyre Avenue to 138 Street – Grand Concourse

5 Line Southbound - Dyre Av to 138 St-Grand Concourse Event Recorder vs. Simulation



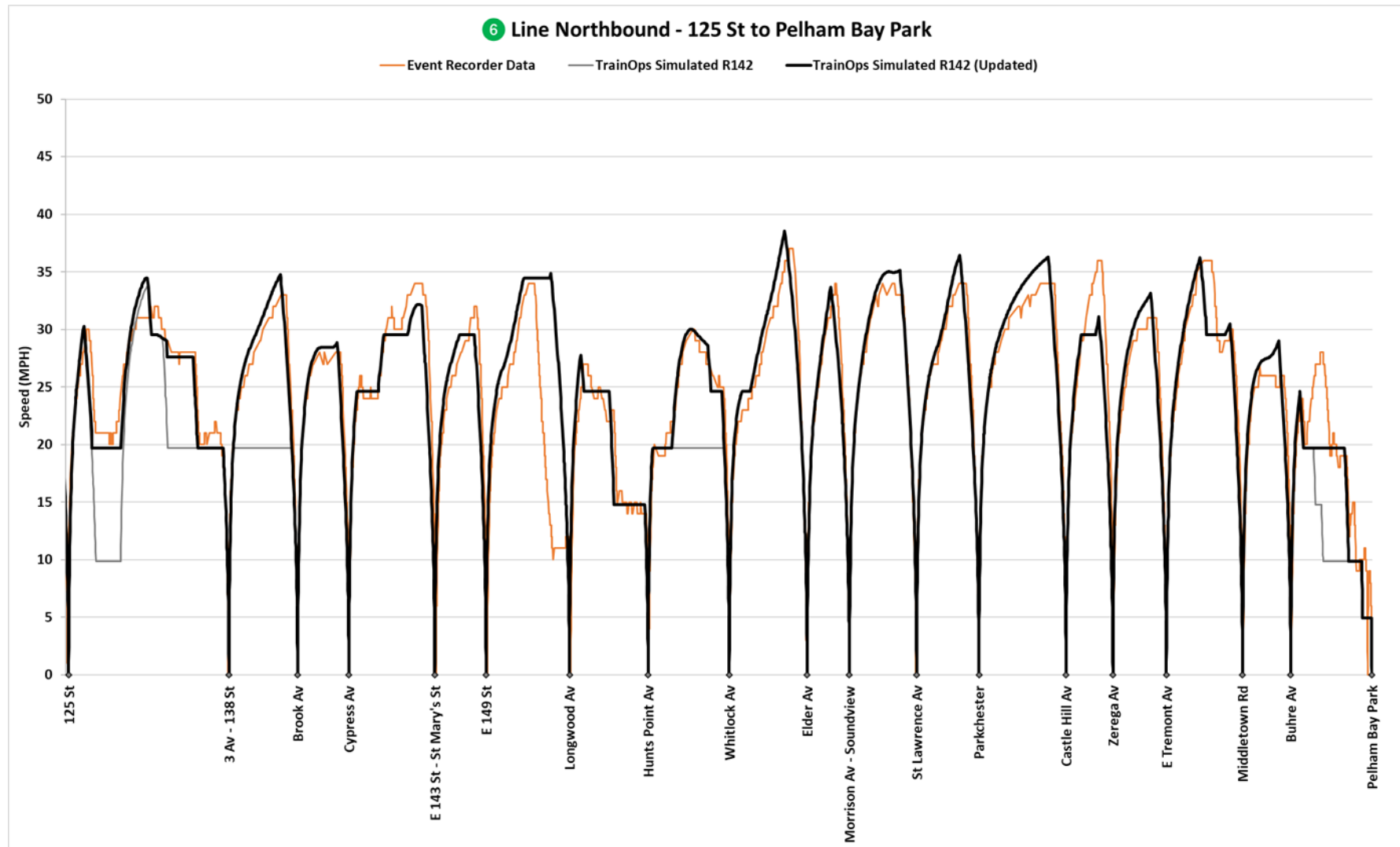
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Figure F.2-25. 6 Line Northbound, Brooklyn Bridge – City Hall to 125 Street



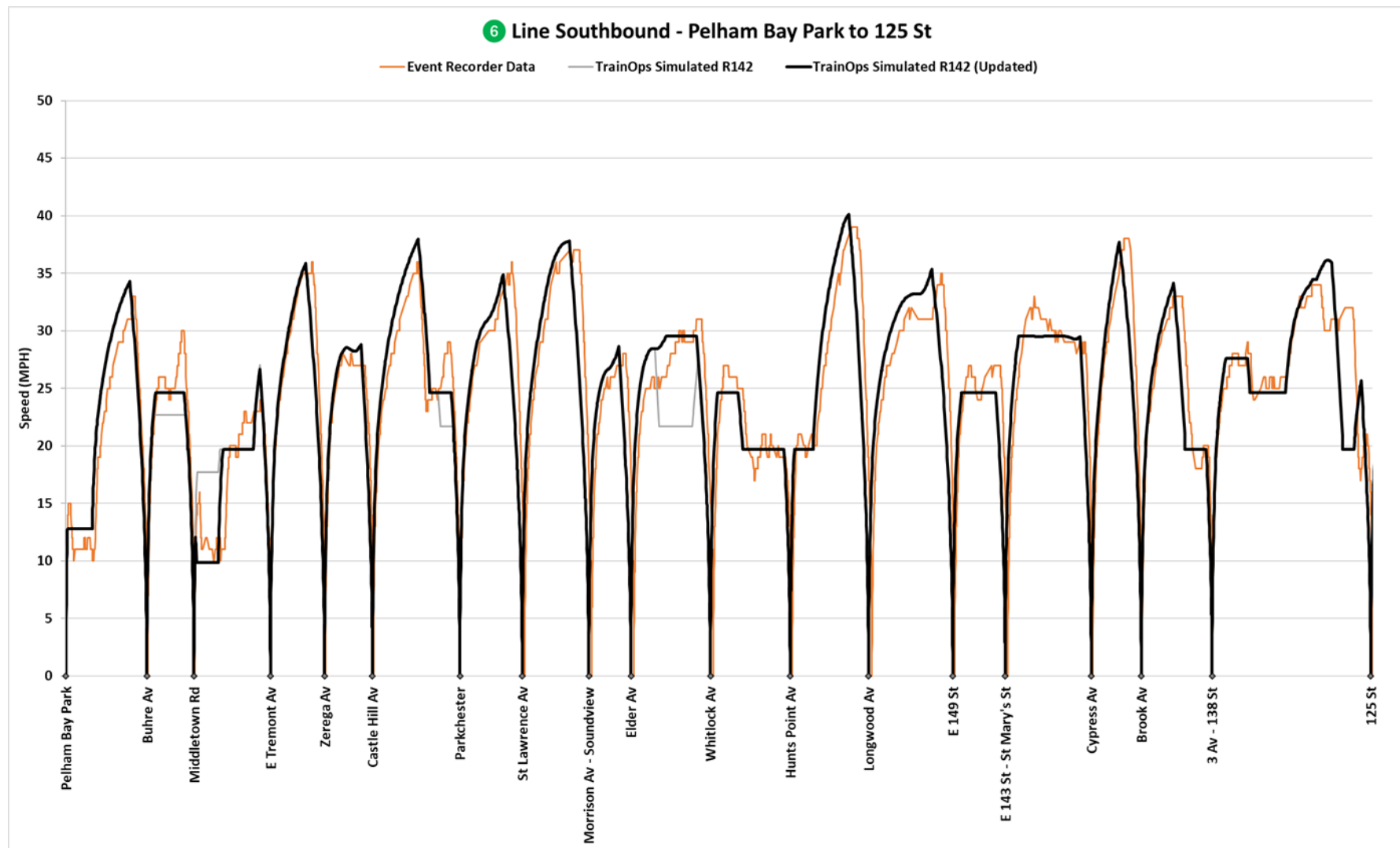
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Figure F.2-26. 6 Line Northbound, 125 Street to Pelham Bay Park



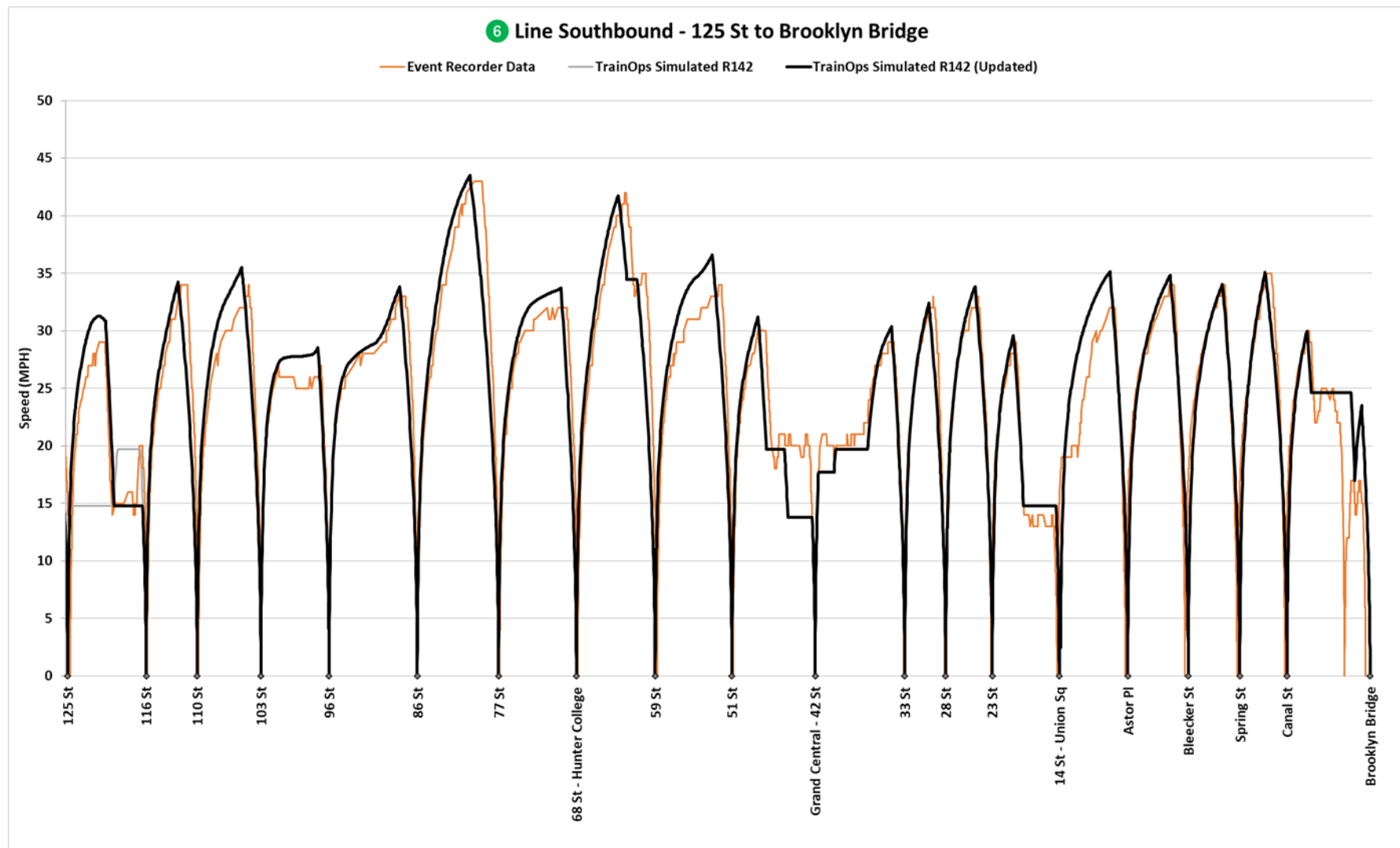
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Figure F.2-27. 6 Line Southbound, Pelham Bay Park to 125 Street



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Figure F.2-28. 6 Line Southbound, 125 Street to Brooklyn Bridge – City Hall



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F.3 Time-Distance (“String”) Charts

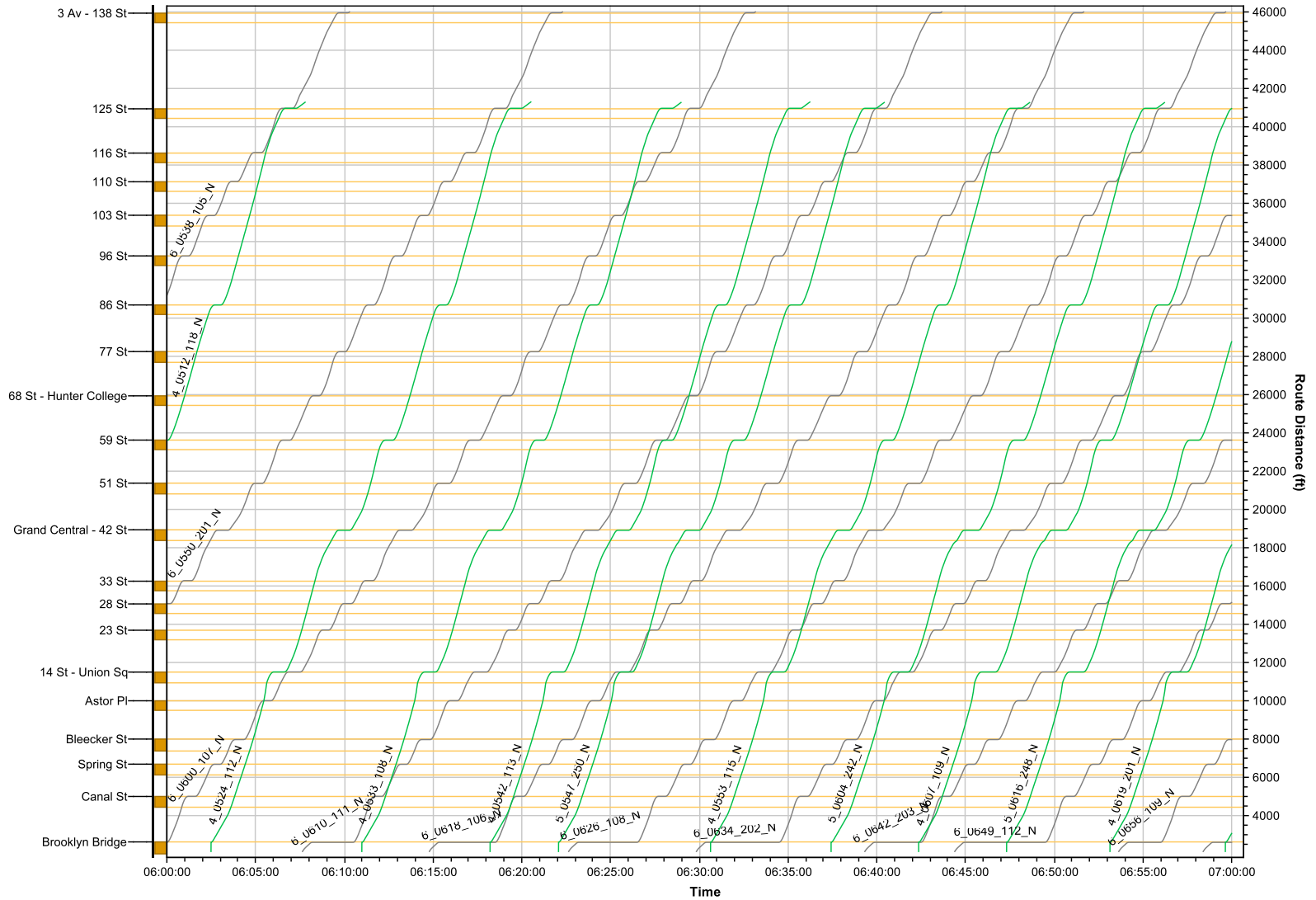
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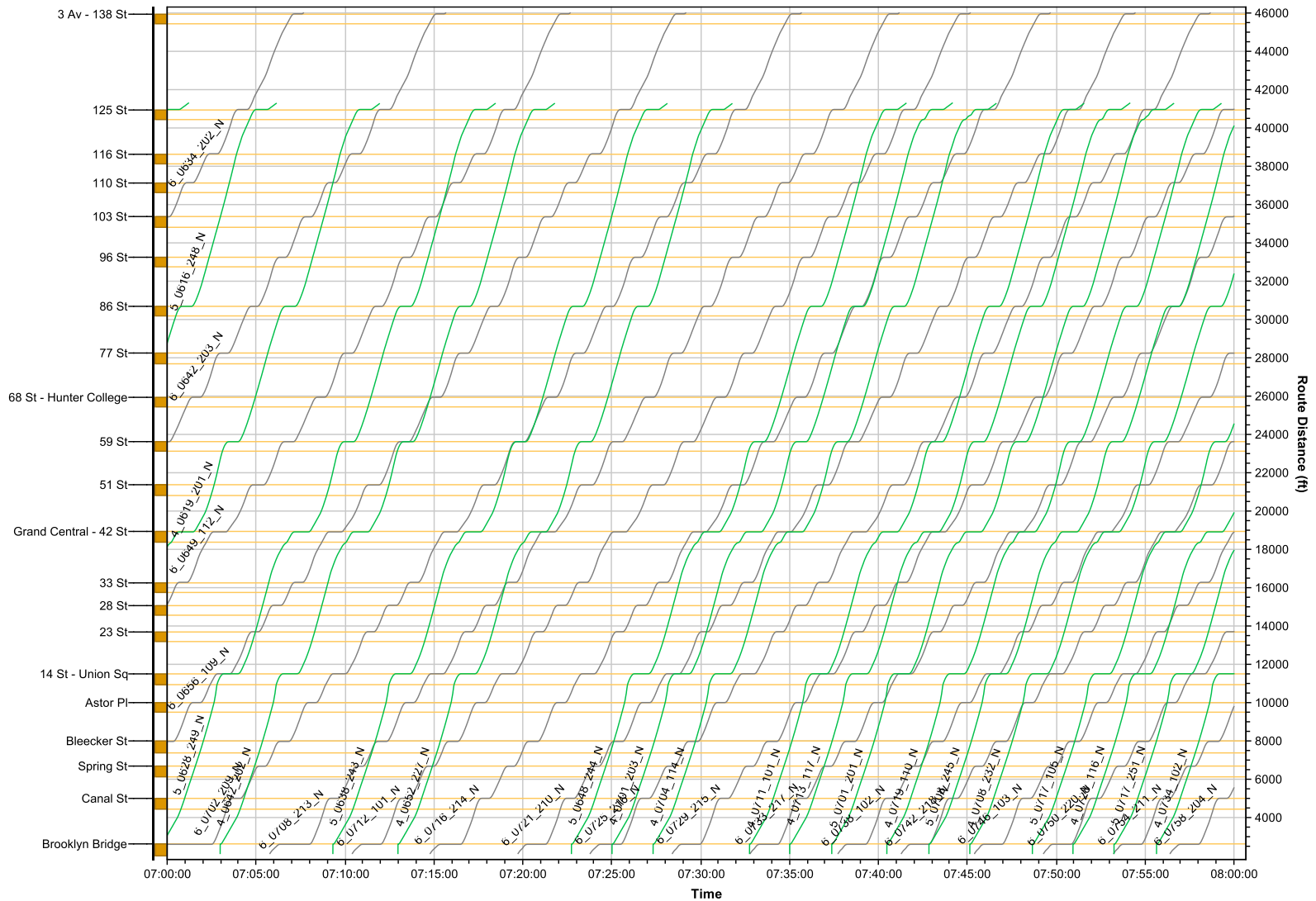
F.3.1 138 Street to Brooklyn Bridge

Figure F.3-1: String Chart - Brooklyn Bridge to 138 Street - Northbound - 6:00 to 7:00 a.m.



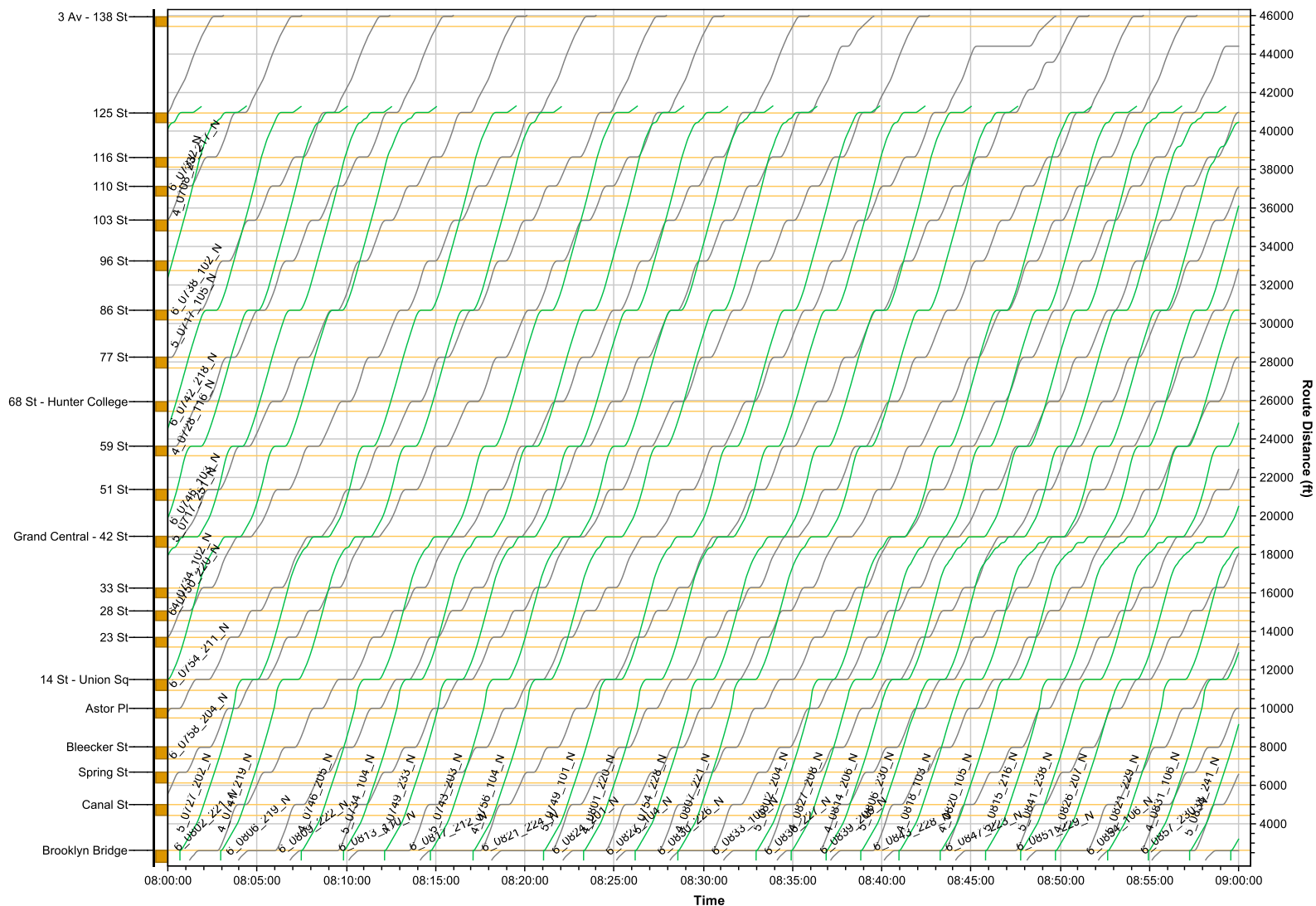
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Figure F.3-2: String Chart – Brooklyn Bridge to 138 Street - Northbound - 7:00 to 8:00 a.m.



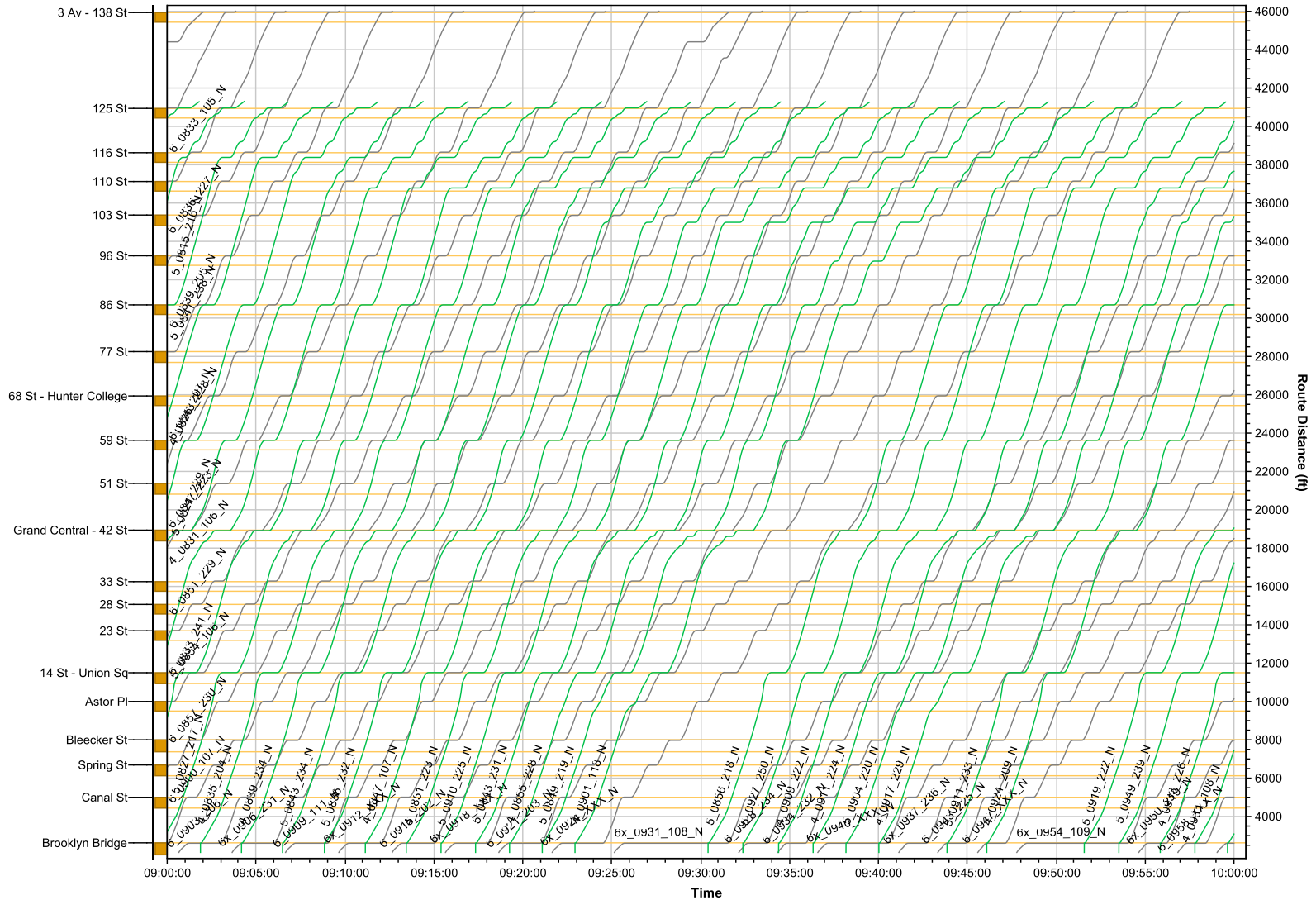
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Figure F.3-3: String Chart – Brooklyn Bridge to 138 Street - Northbound - 8:00 to 9:00 a.m.



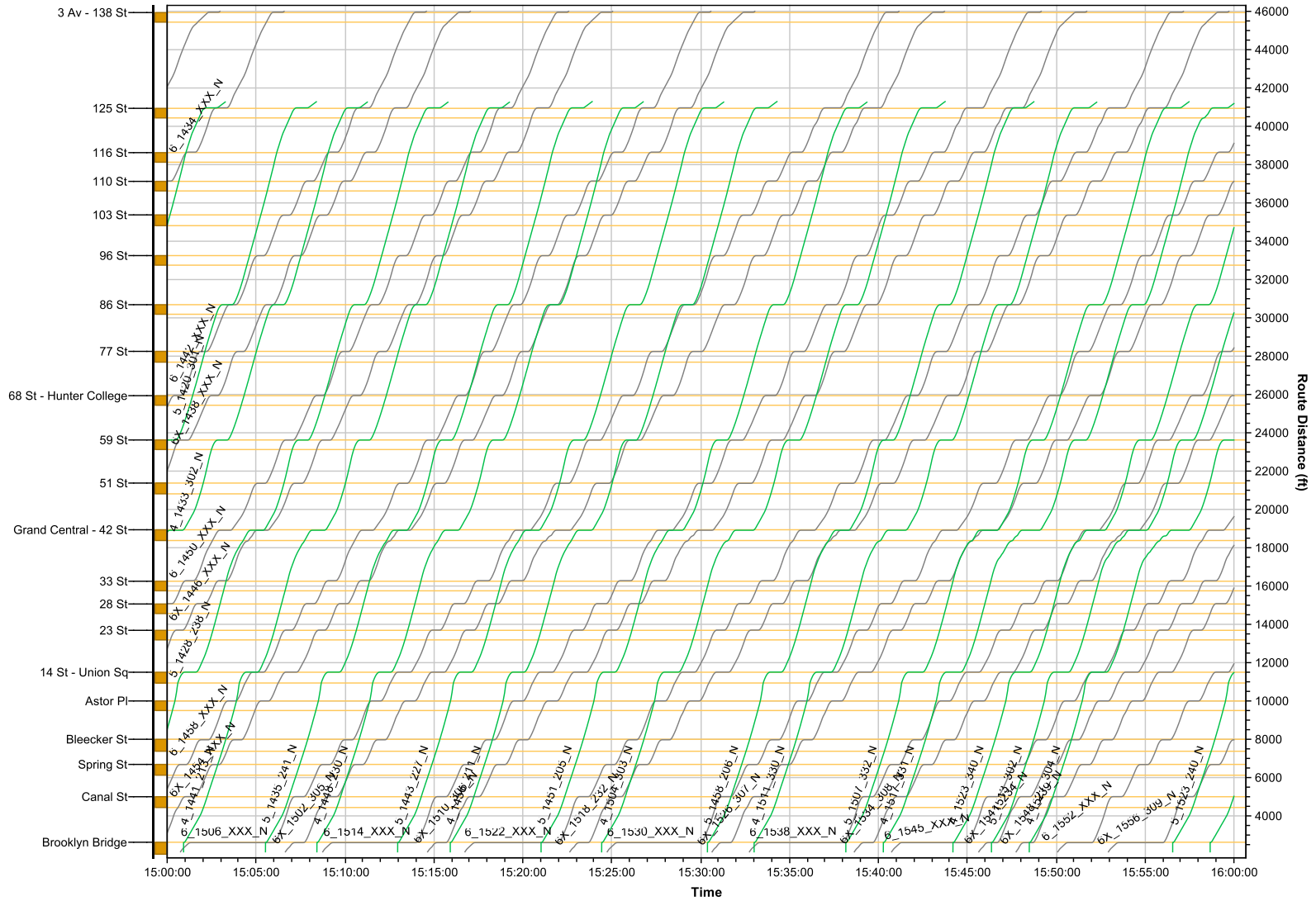
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Figure F.3-4: String Chart - Brooklyn Bridge to 138 Street - Northbound - 9:00 to 10:00 a.m.



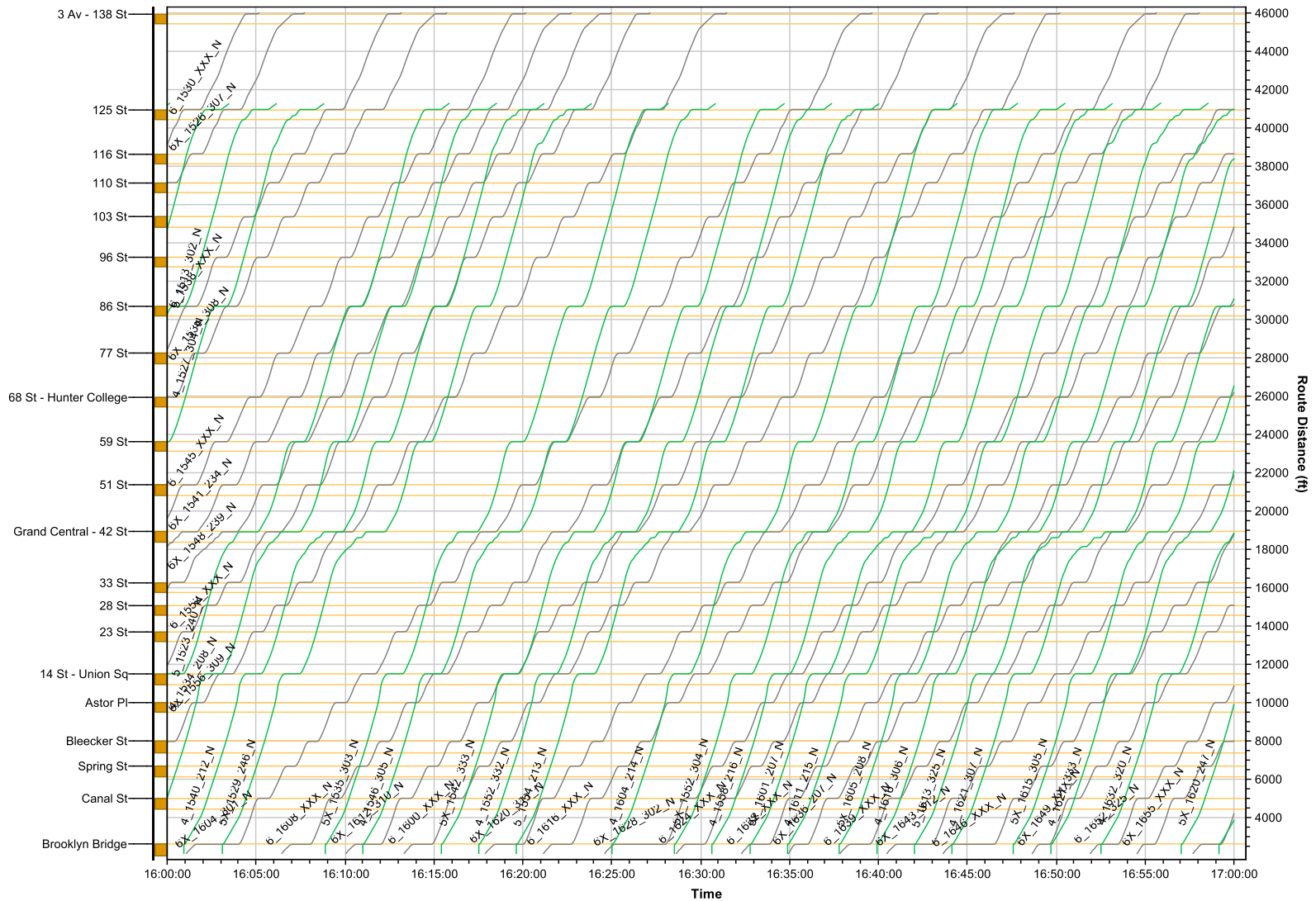
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Figure F.3-5: String Chart - Brooklyn Bridge to 138 Street - Northbound - 3:00 to 4:00 p.m.



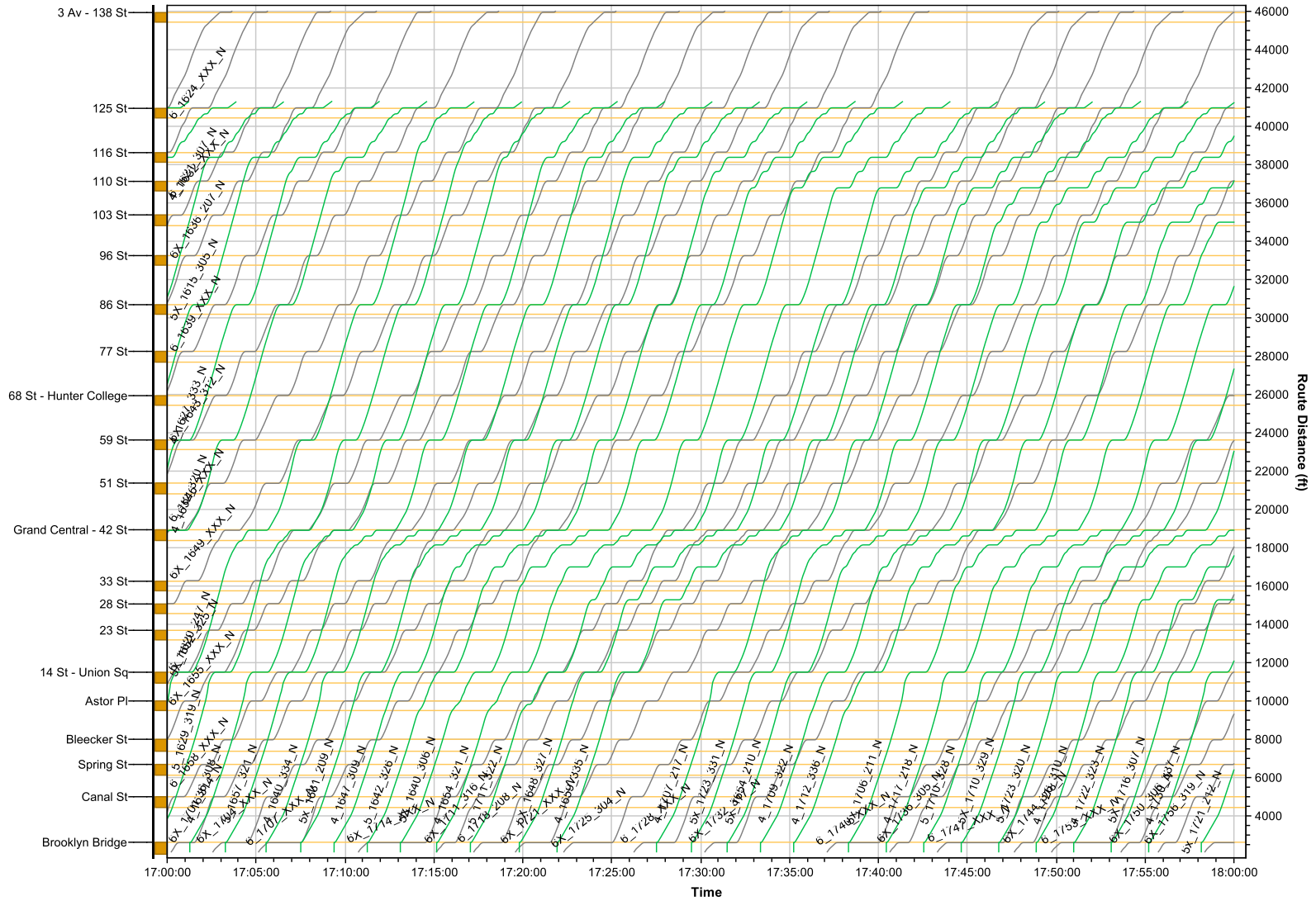
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Figure F.3-6: String Chart - Brooklyn Bridge to 138 Street - Northbound - 4:00 to 5:00 p.m.



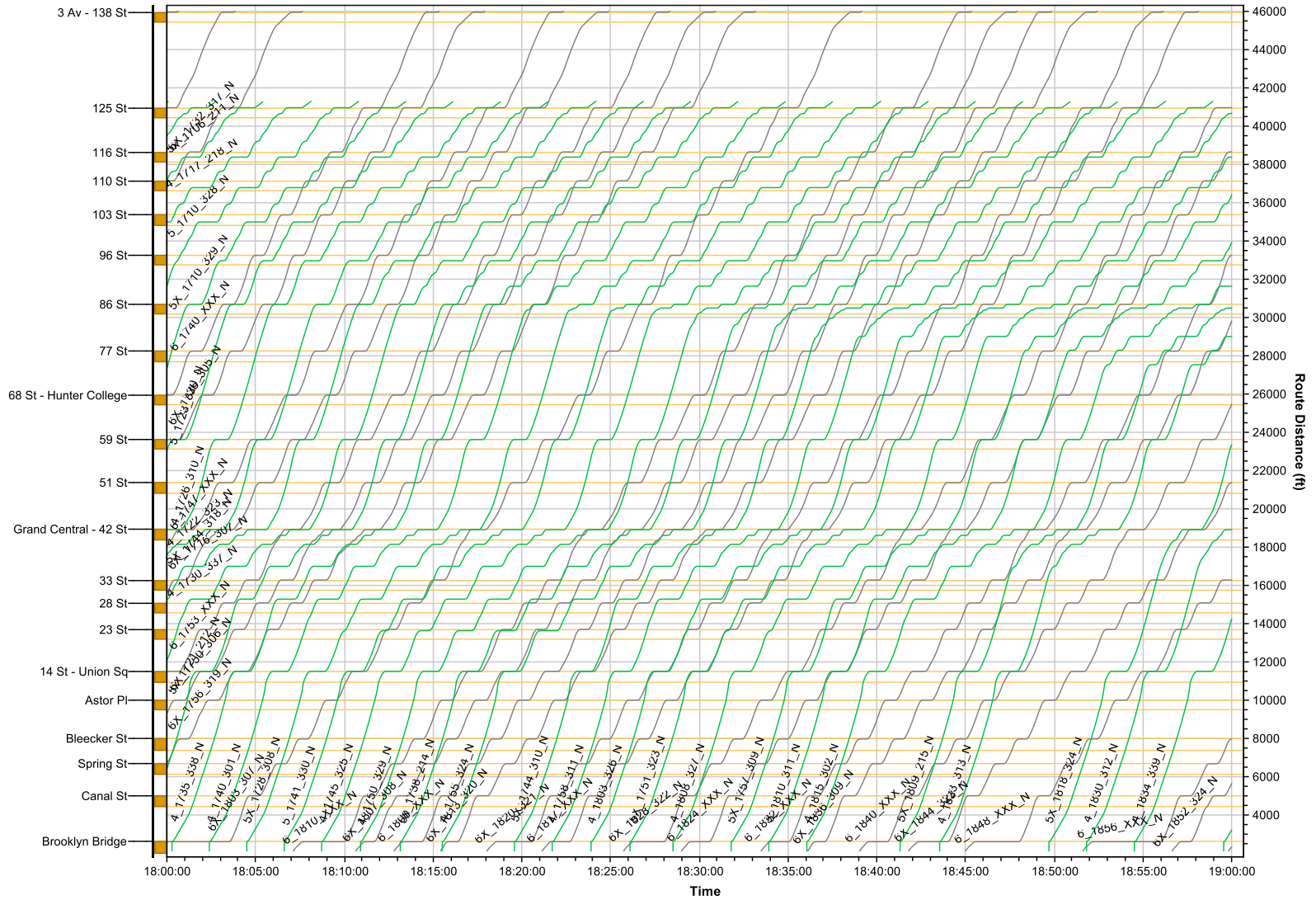
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Figure F.3-7: String Chart - Brooklyn Bridge to 138 Street - Northbound - 5:00 to 6:00 p.m.



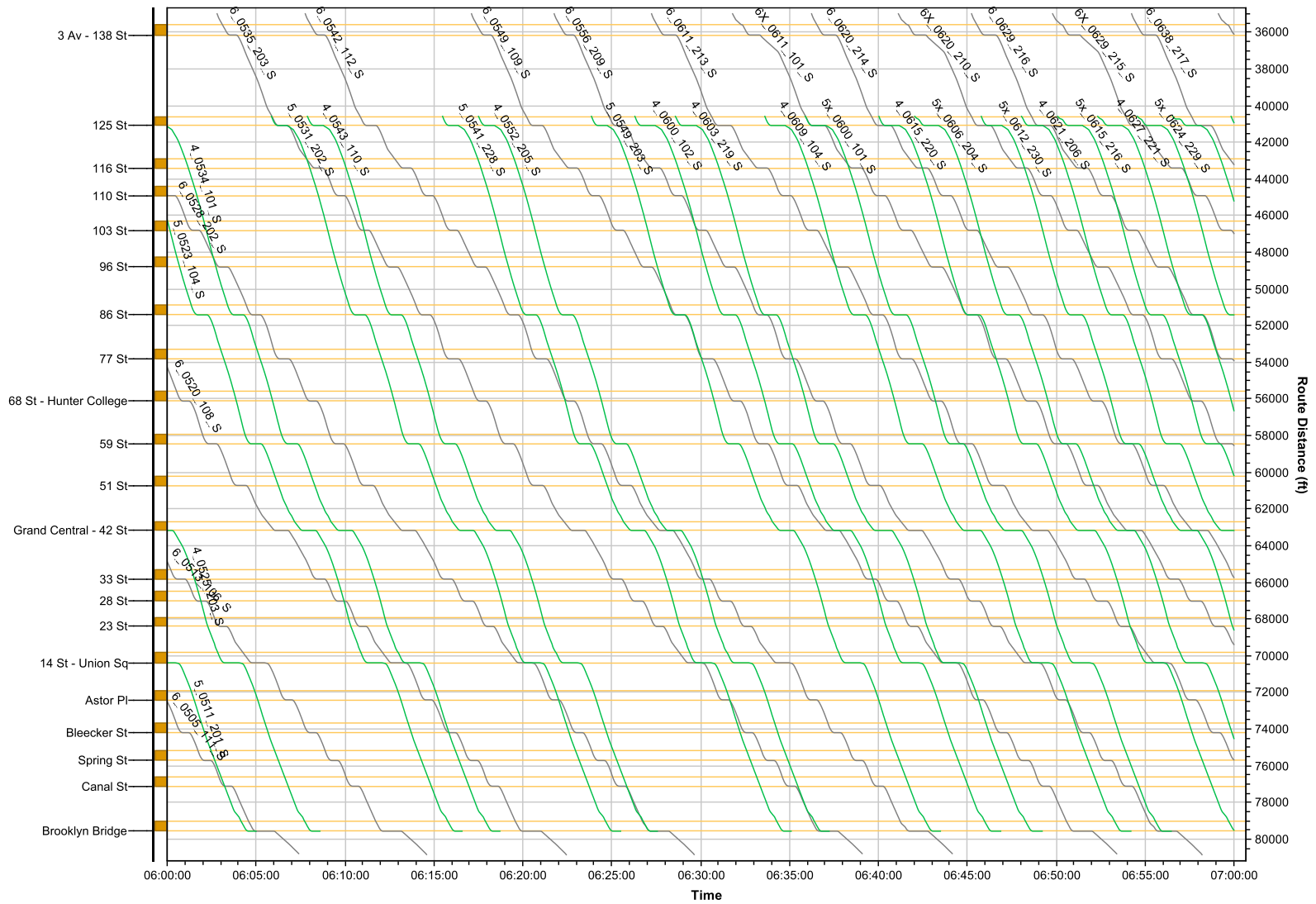
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-8: String Chart - Brooklyn Bridge to 138 Street - Northbound - 6:00 to 7:00 p.m.



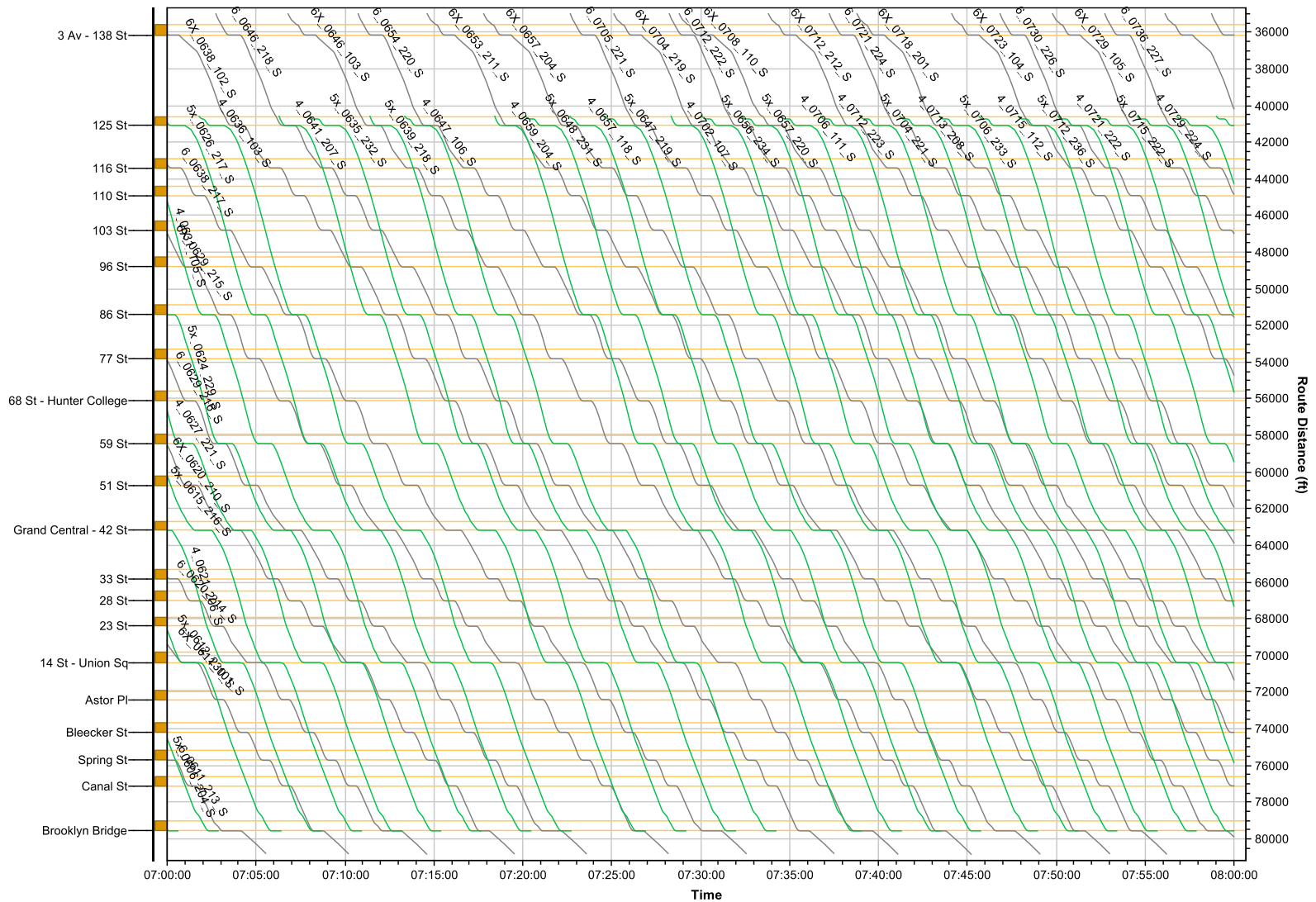
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-9: String Chart - 138 Street to Brooklyn Bridge - Southbound - 6:00 to 7:00 a.m.



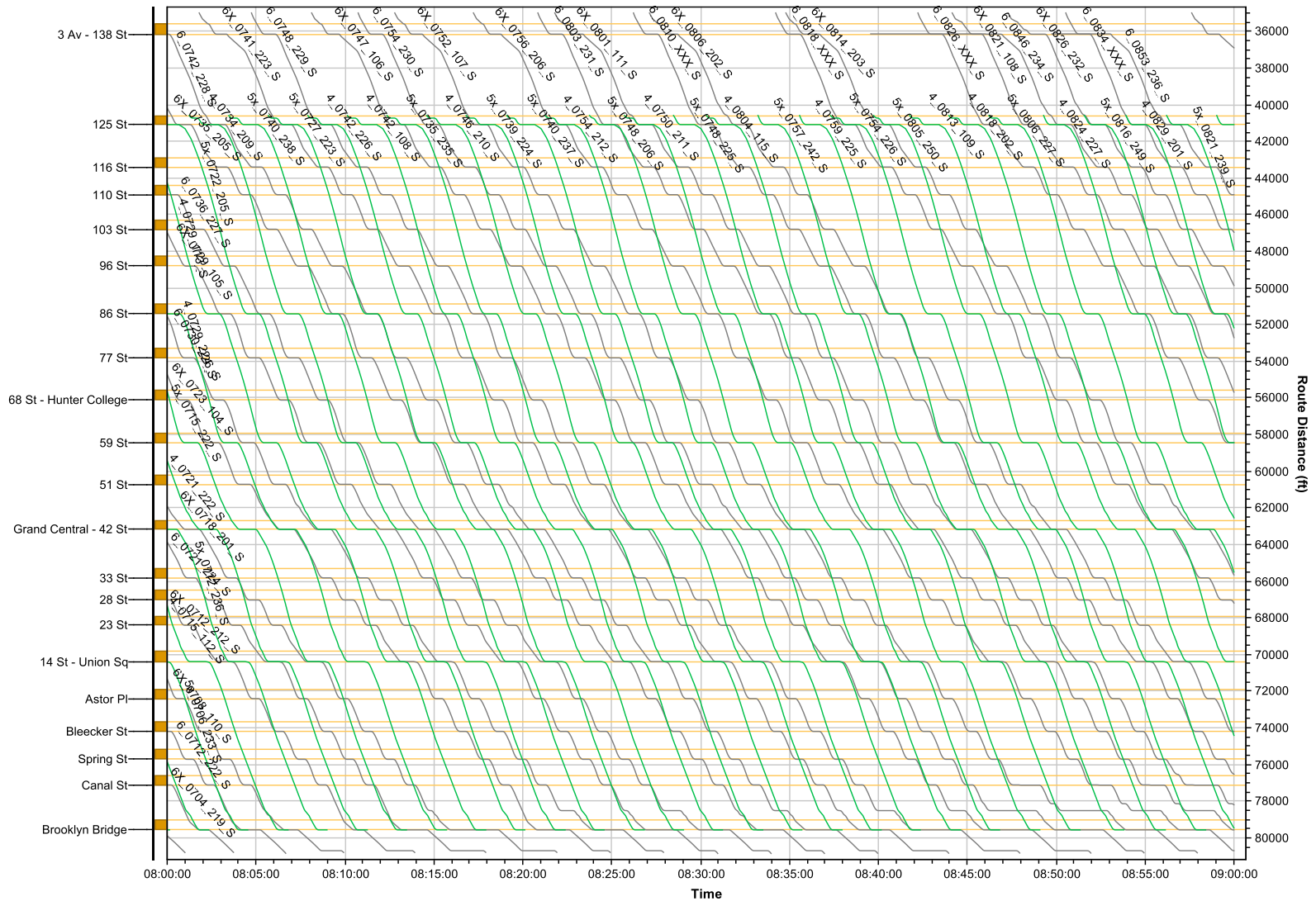
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-10: String Chart - 138 Street to Brooklyn Bridge - Southbound - 7:00 to 8:00 a.m.



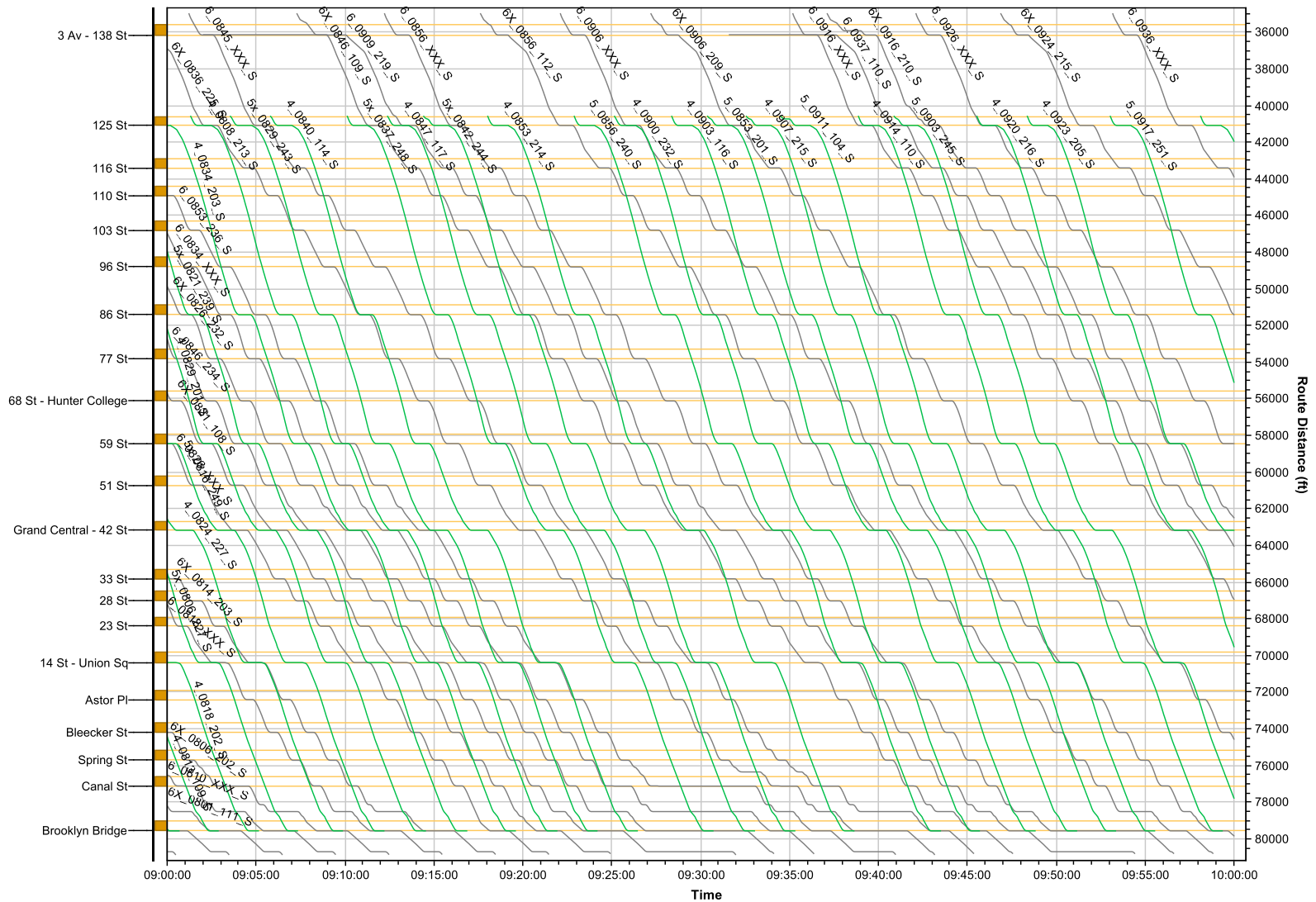
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-11: String Chart - 138 Street to Brooklyn Bridge - Southbound - 8:00 to 9:00 a.m.



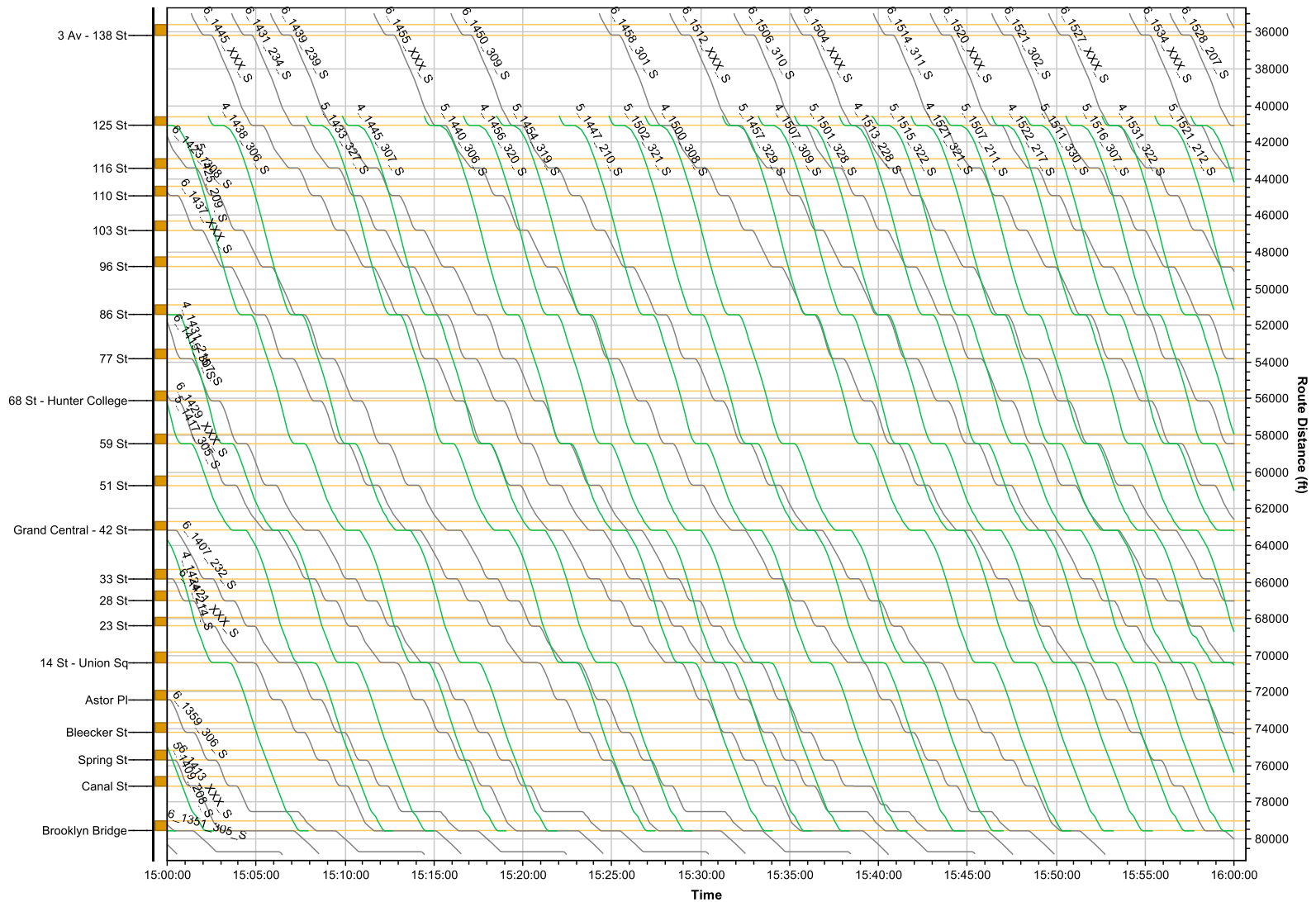
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-12: String Chart - 138 Street to Brooklyn Bridge - Southbound - 9:00 to 10:00 a.m.



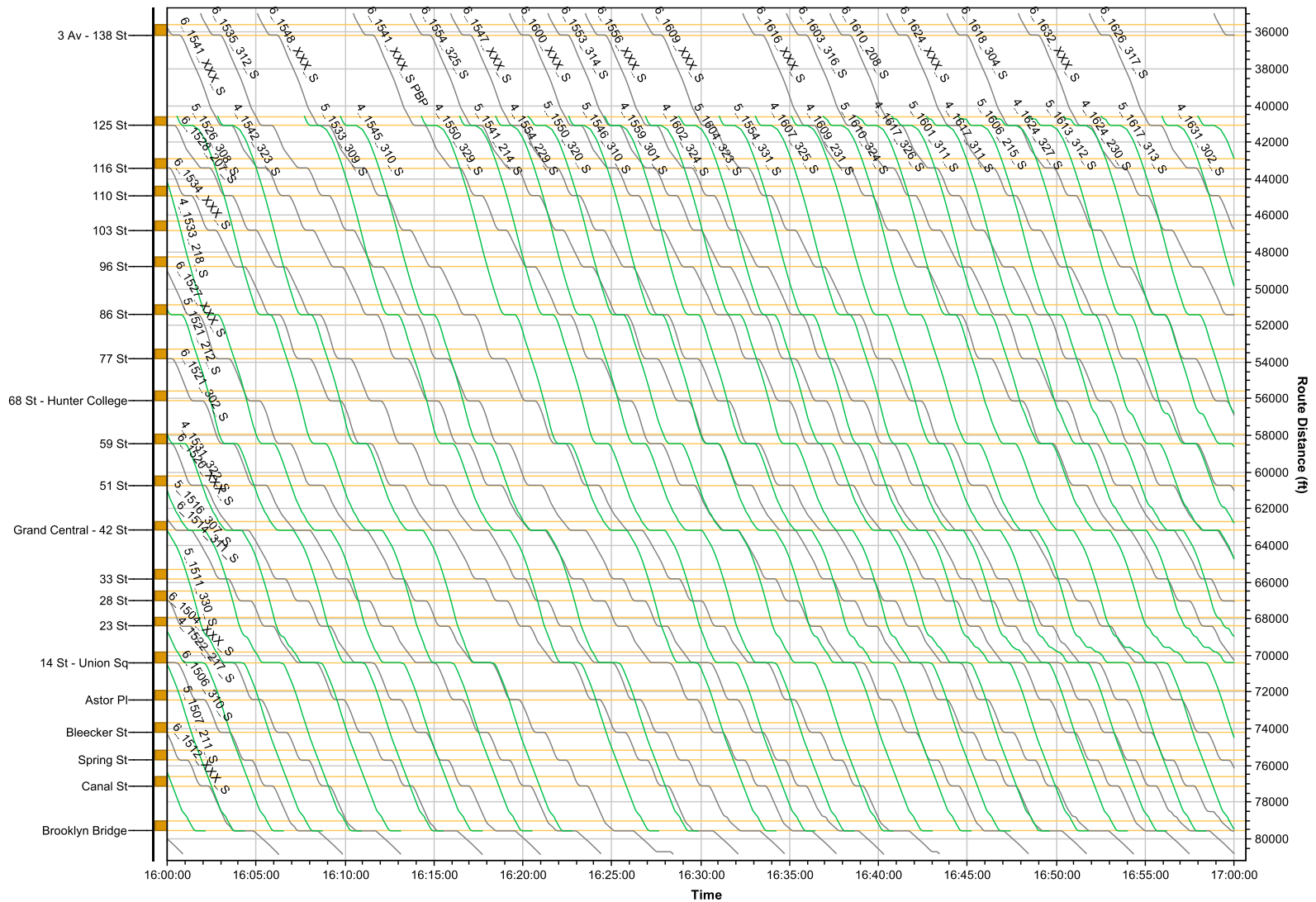
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-13: String Chart - 138 Street to Brooklyn Bridge - Southbound - 3:00 to 4:00 p.m.



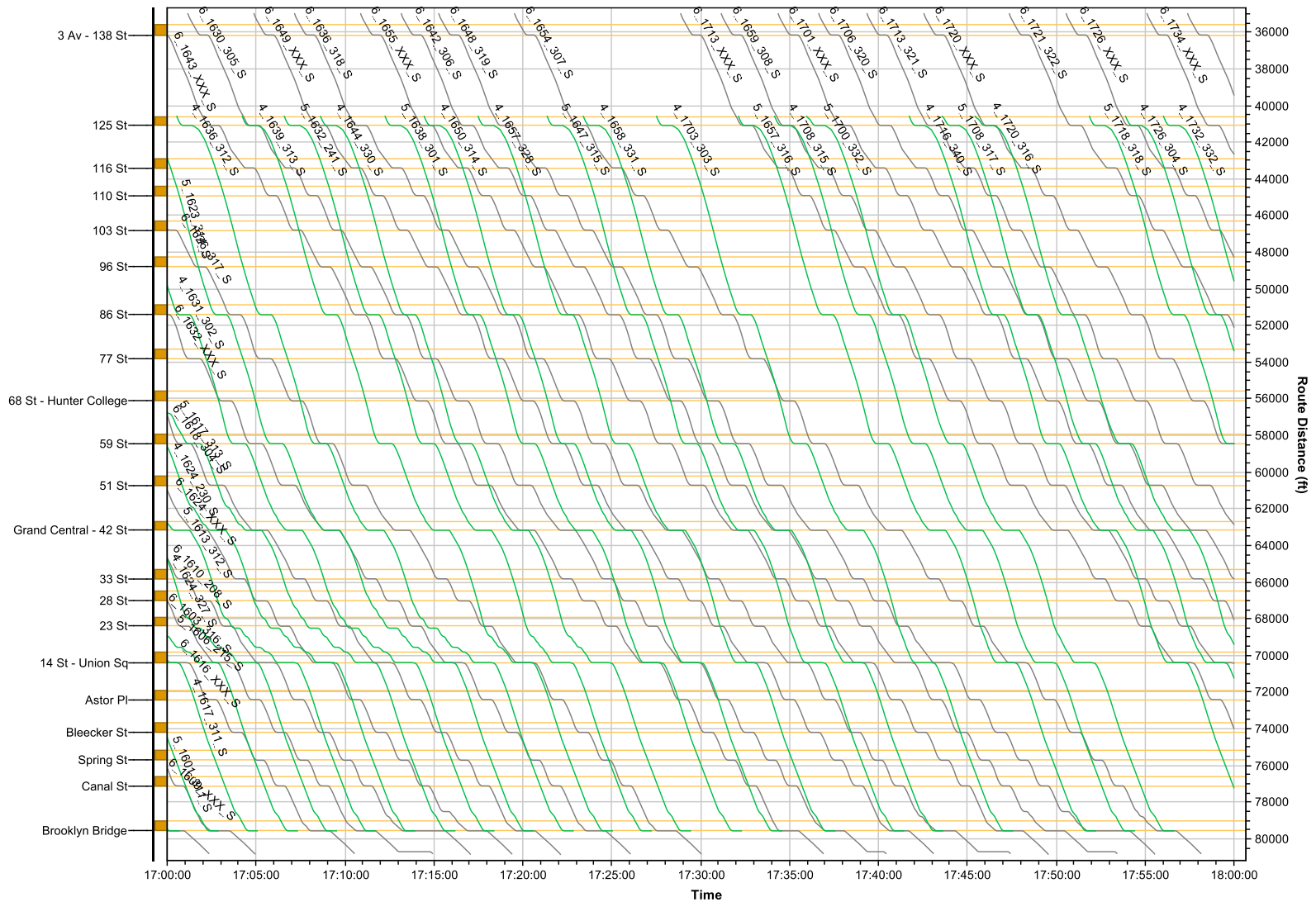
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-14: String Chart - 138 Street to Brooklyn Bridge - Southbound - 4:00 to 5:00 p.m.



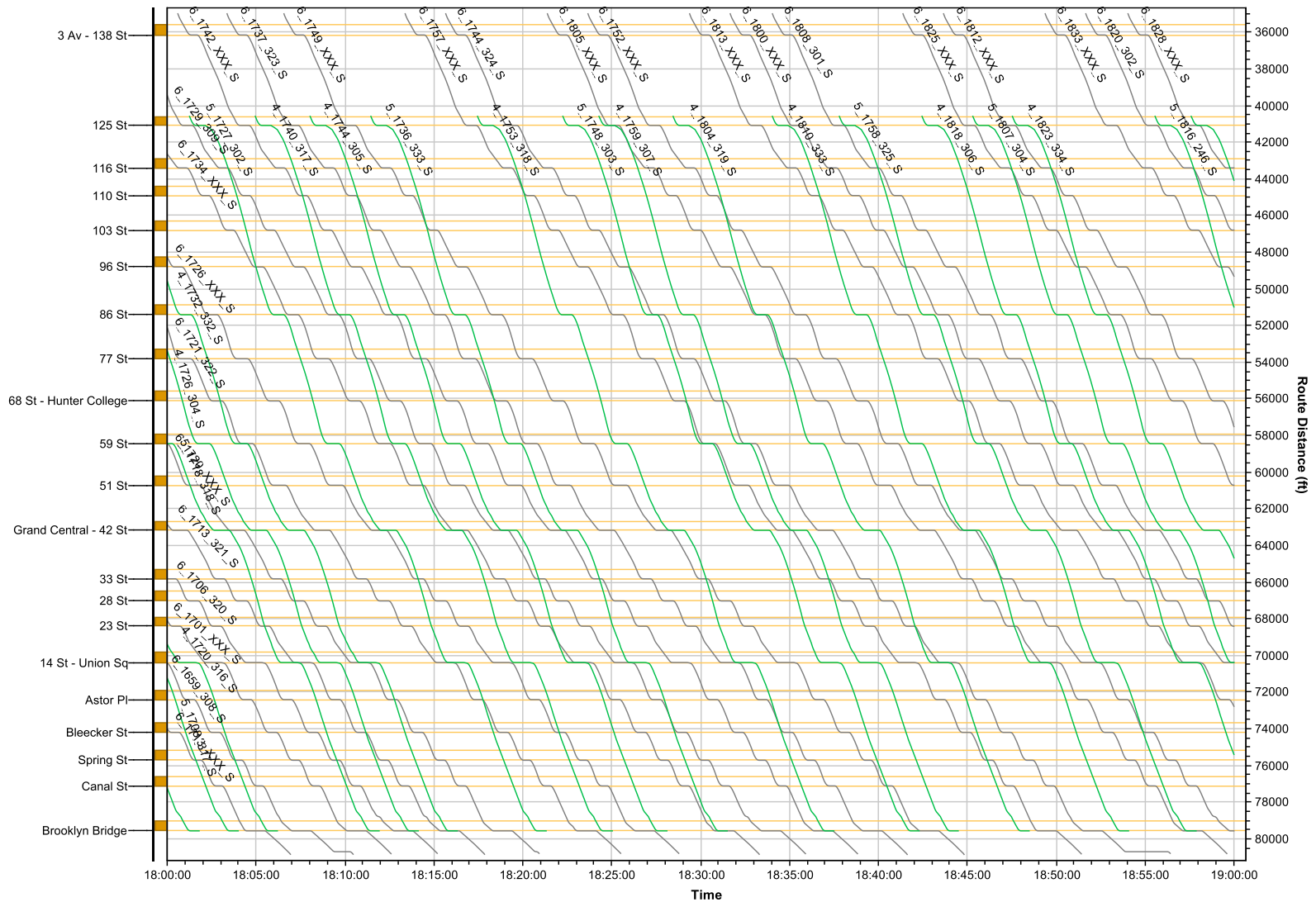
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Figure F.3-15: String Chart - 138 Street to Brooklyn Bridge - Southbound - 5:00 to 6:00 p.m.



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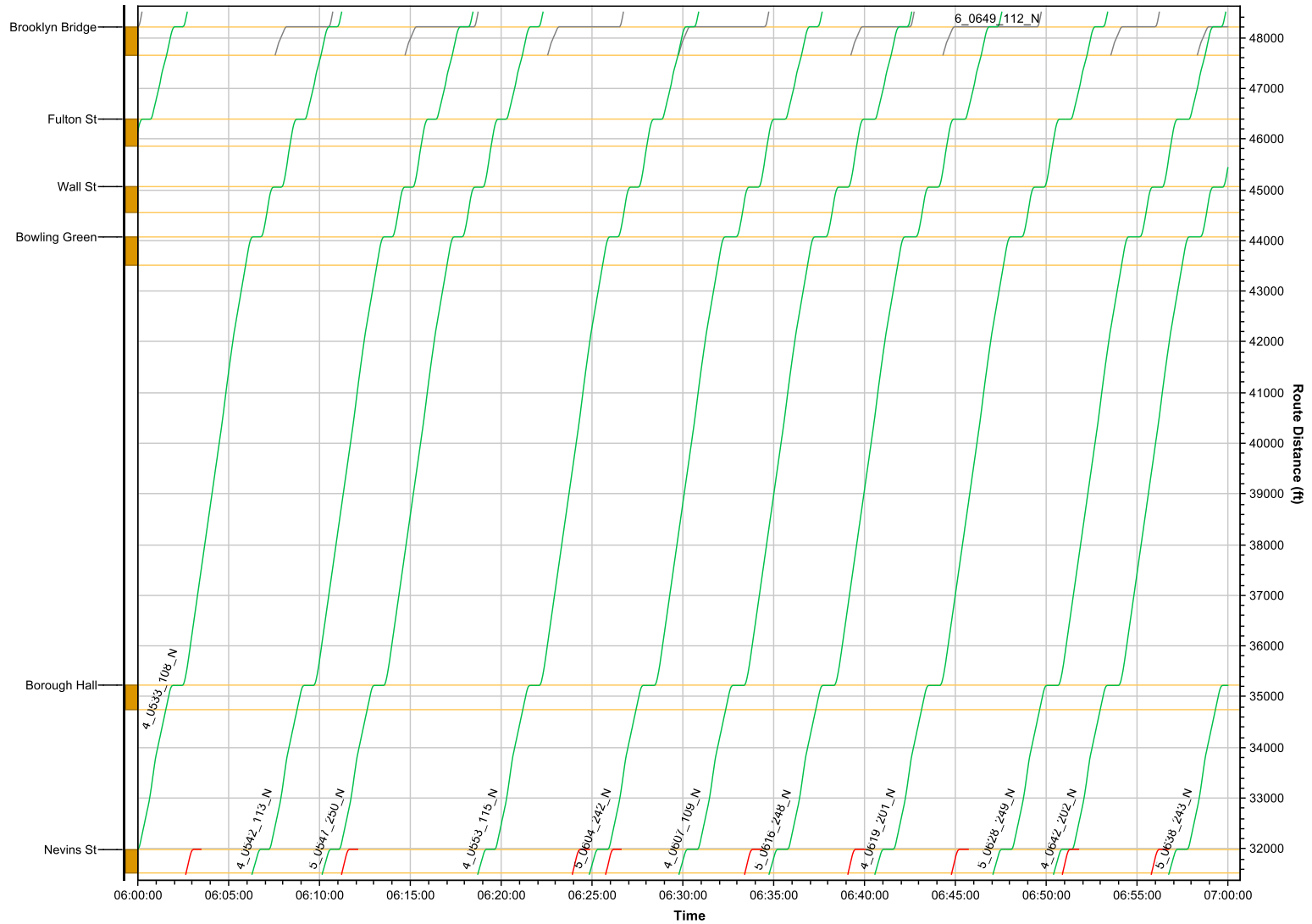
Figure F.3-16: String Chart - 138 Street to Brooklyn Bridge - Southbound - 6:00 to 7:00 p.m.



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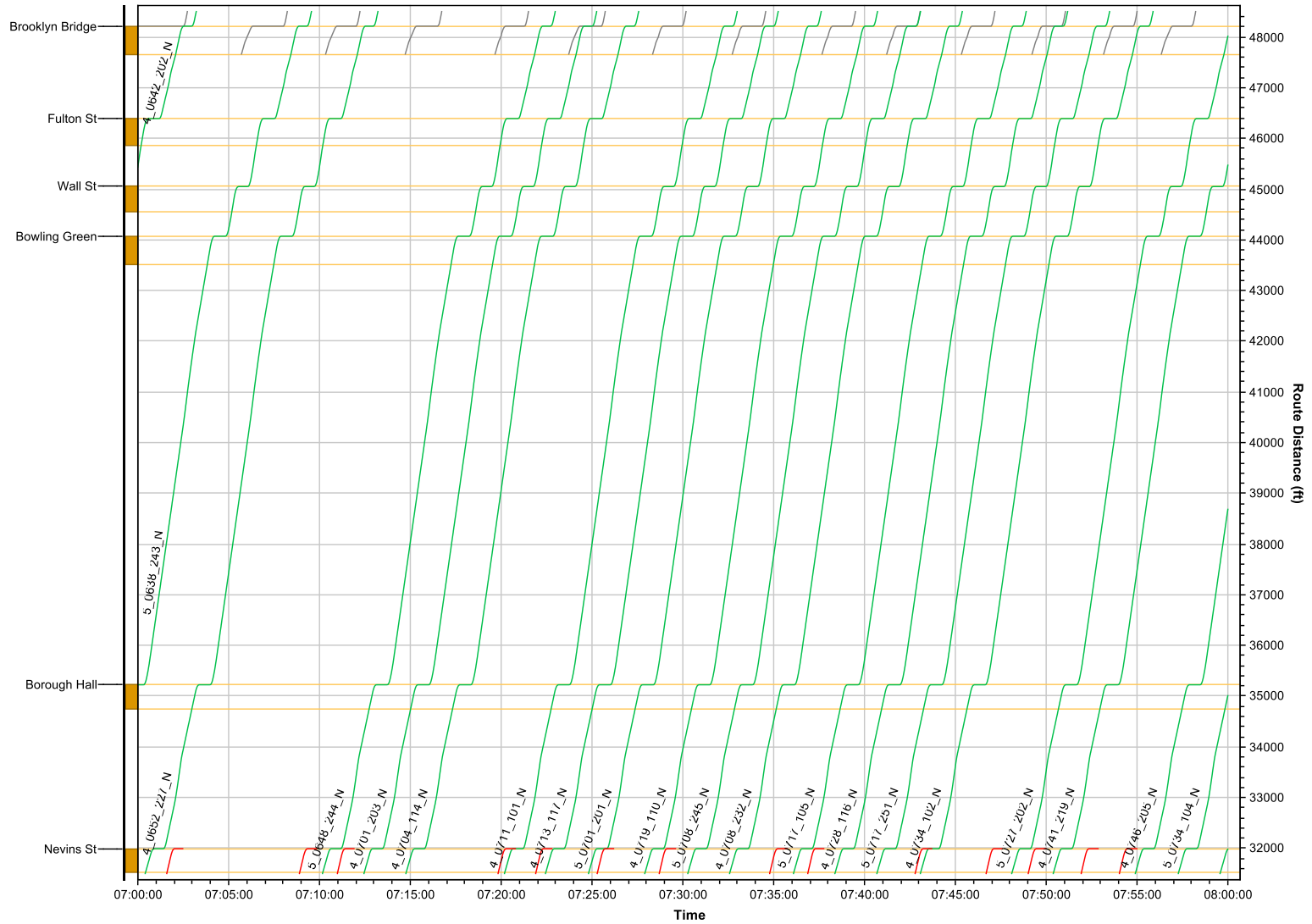
F.3.2 Brooklyn Bridge to Nevins Street

Figure F.3-17: String Chart - Nevins Street to Brooklyn Bridge - Northbound - 6:00 to 7:00 a.m.



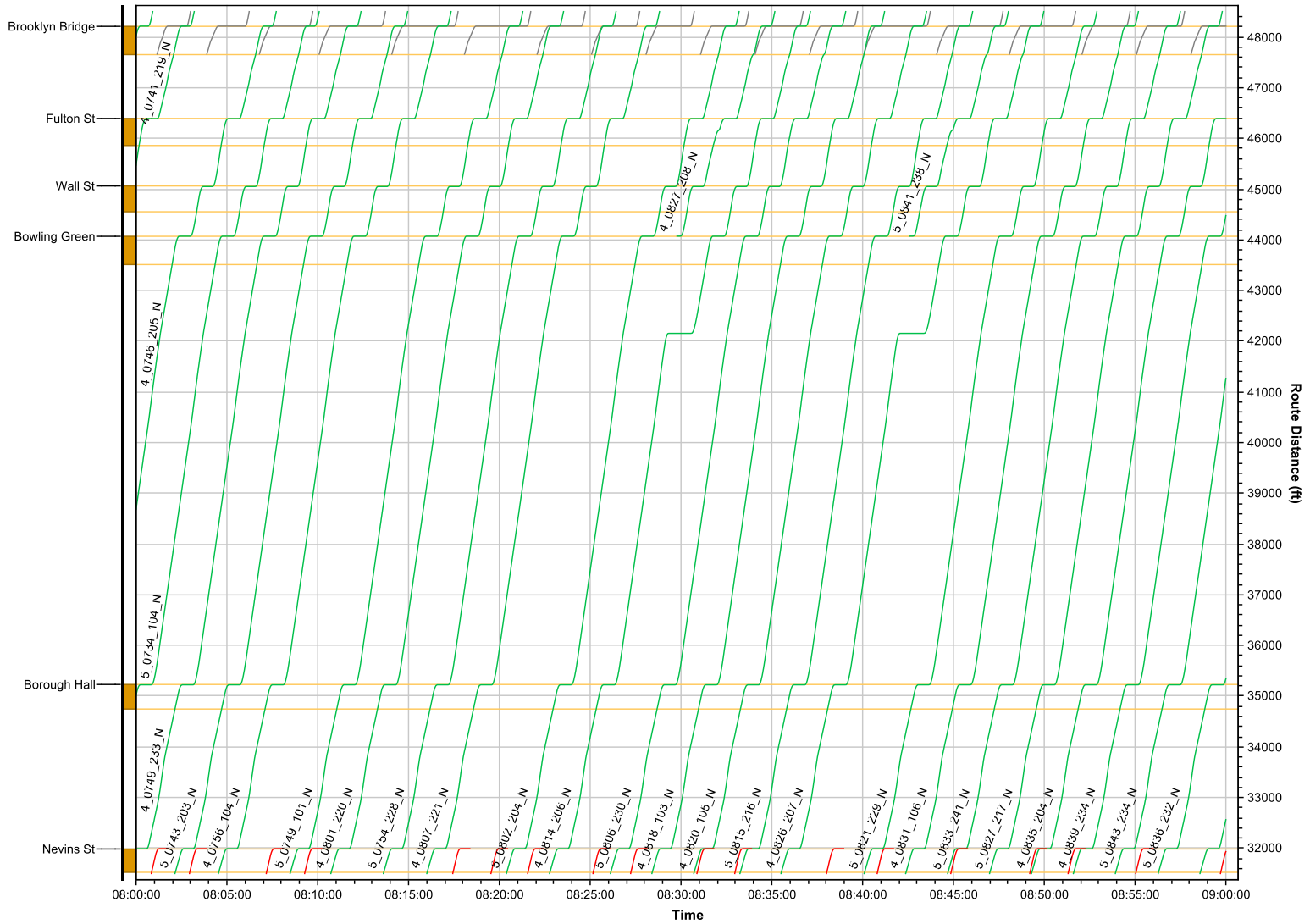
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-18: String Chart – Nevins Street to Brooklyn Bridge - Northbound - 7:00 to 8:00 a.m.



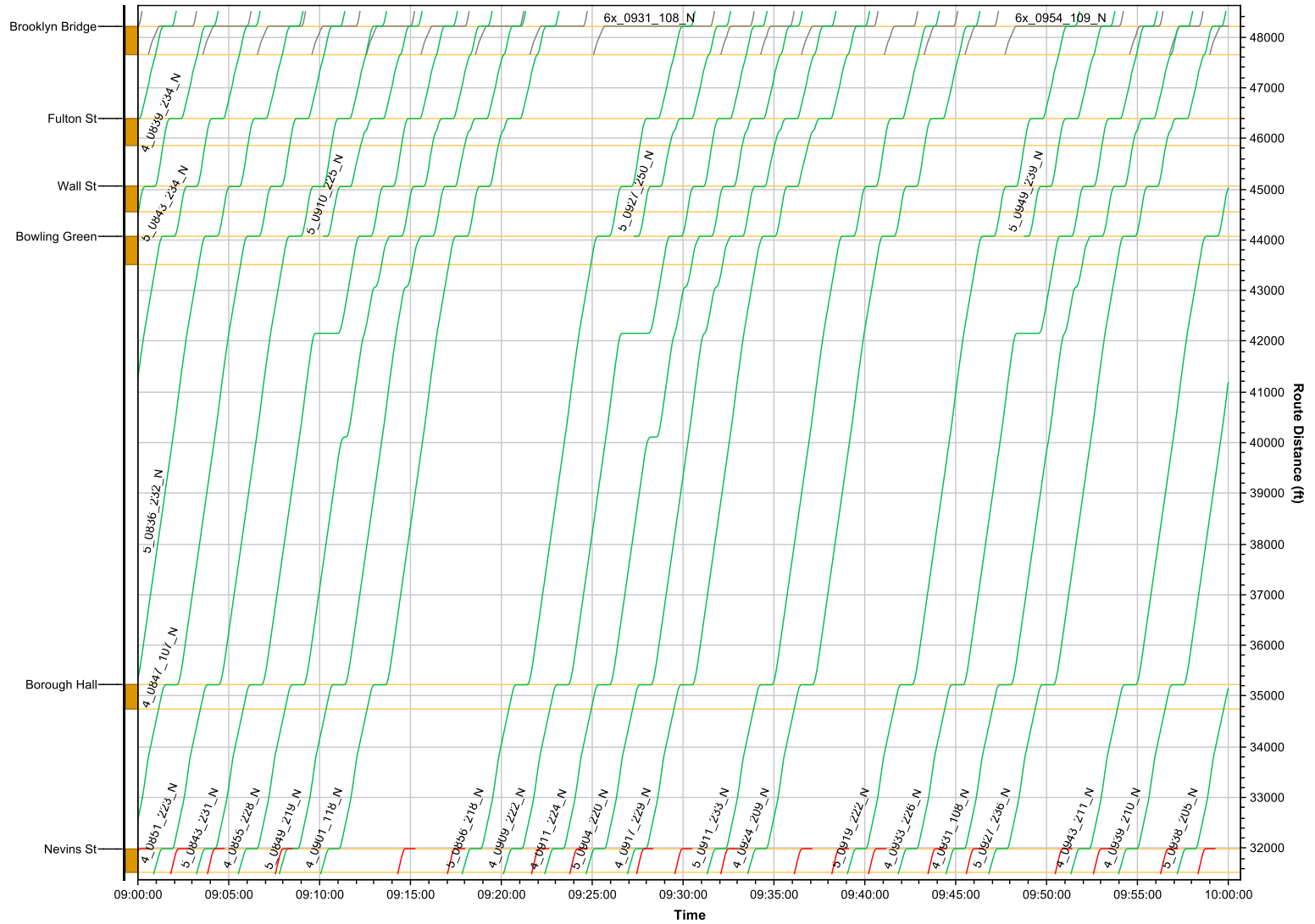
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-19: String Chart – Nevins Street to Brooklyn Bridge - Northbound - 8:00 to 9:00 a.m.



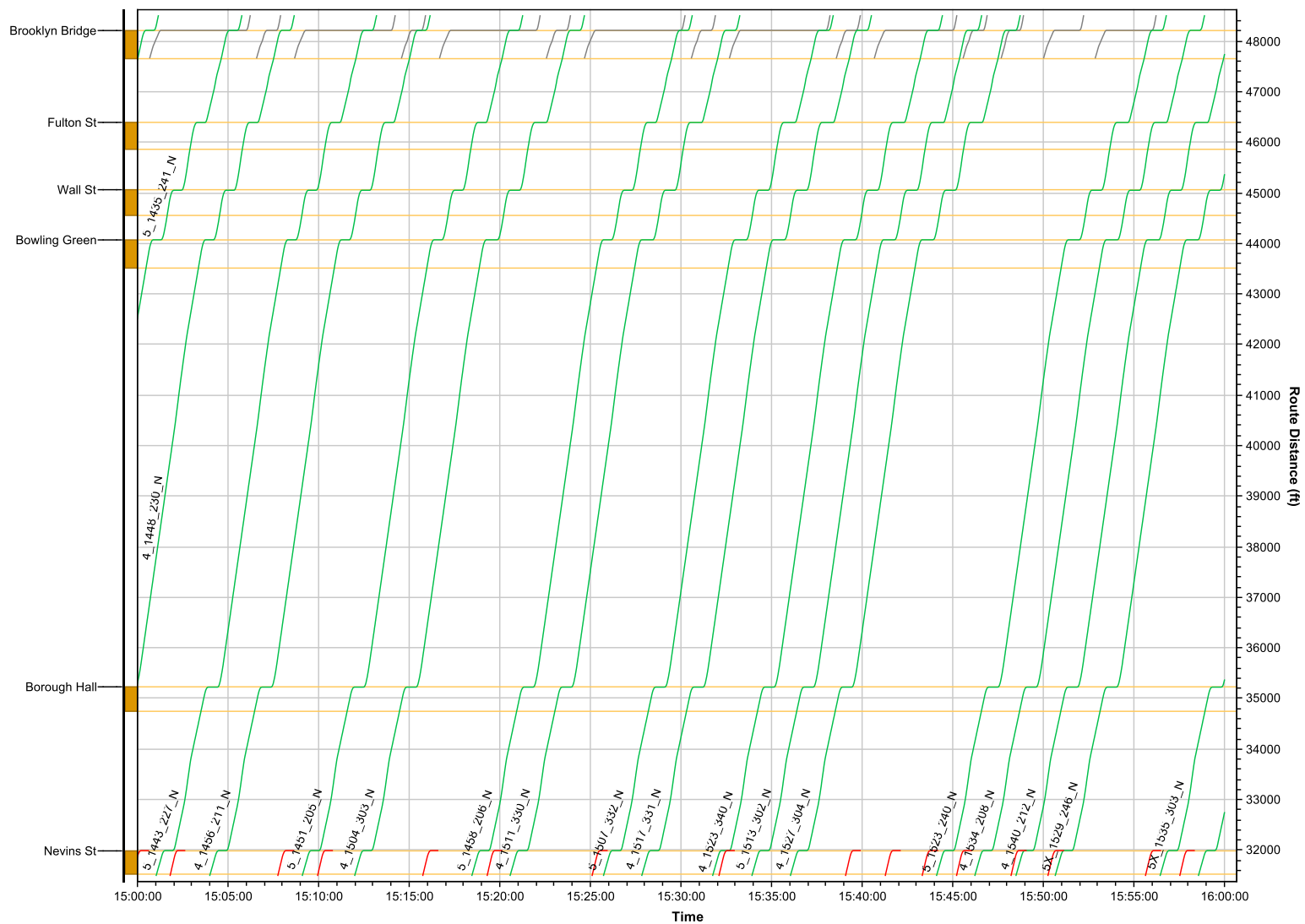
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-20: String Chart - Nevins Street to Brooklyn Bridge - Northbound - 9:00 to 10:00 a.m.



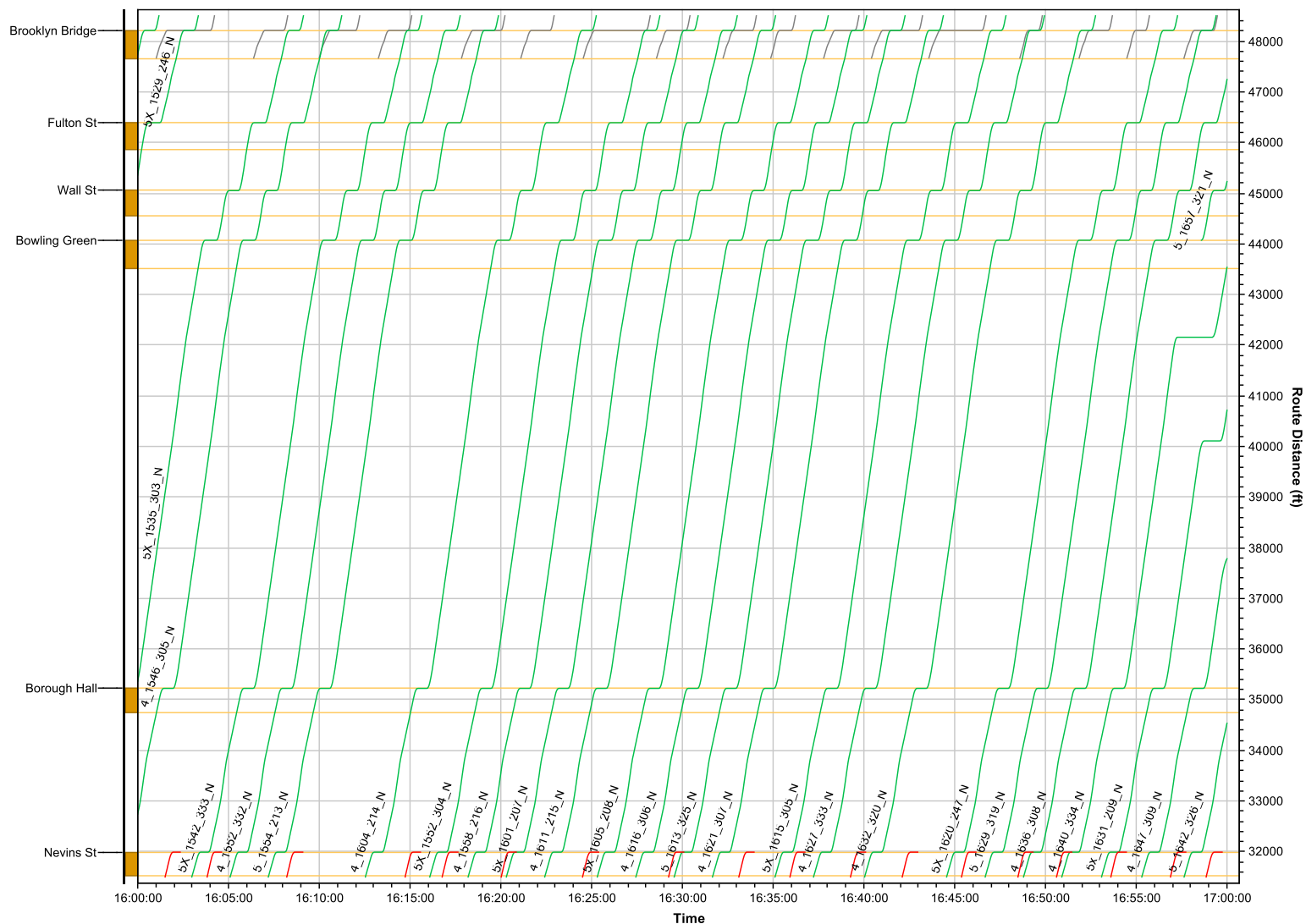
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-21: String Chart - Nevins Street to Brooklyn Bridge - Northbound - 3:00 to 4:00 p.m.



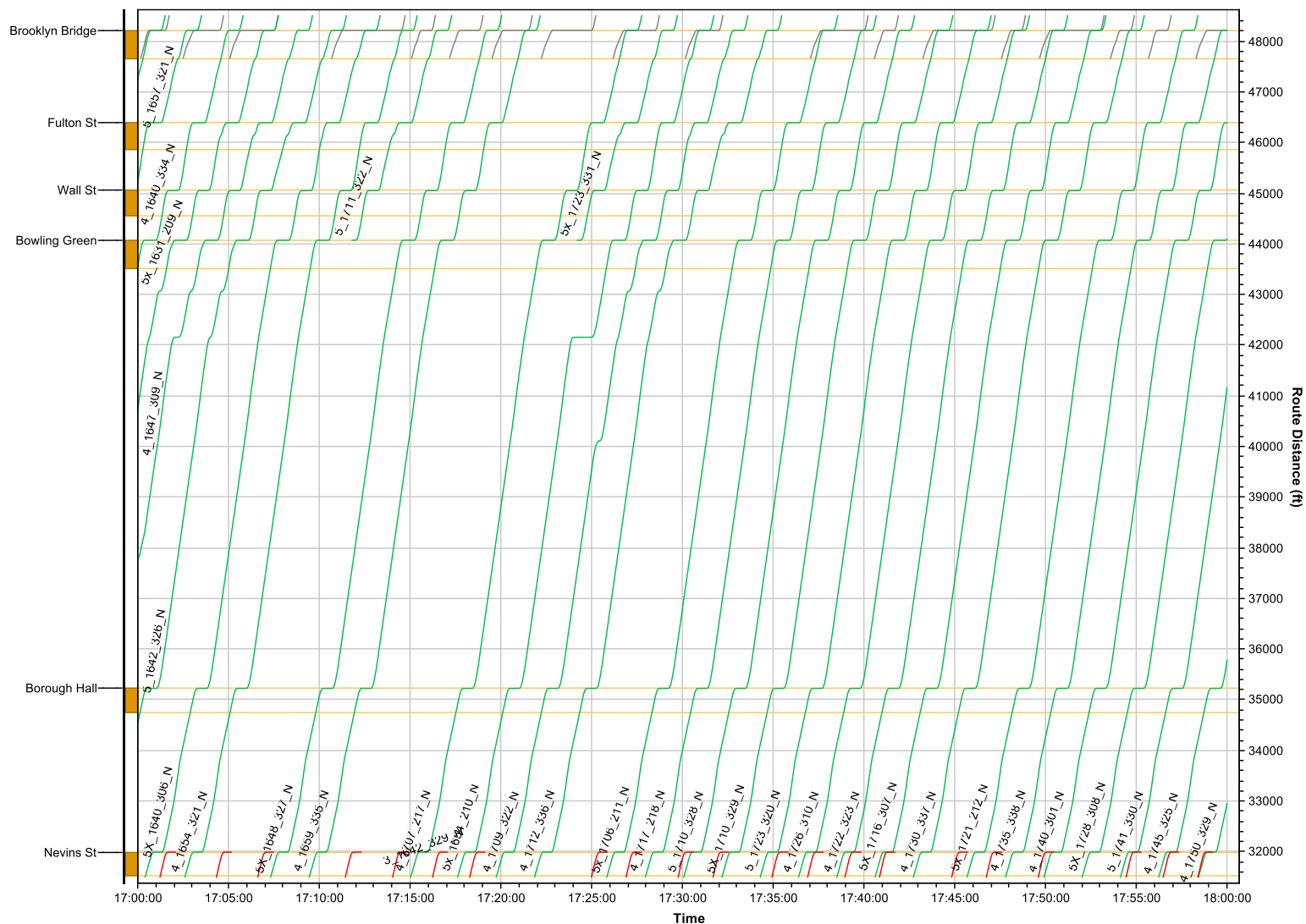
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Figure F.3-22: String Chart - Nevins Street to Brooklyn Bridge - Northbound - 4:00 to 5:00 p.m.



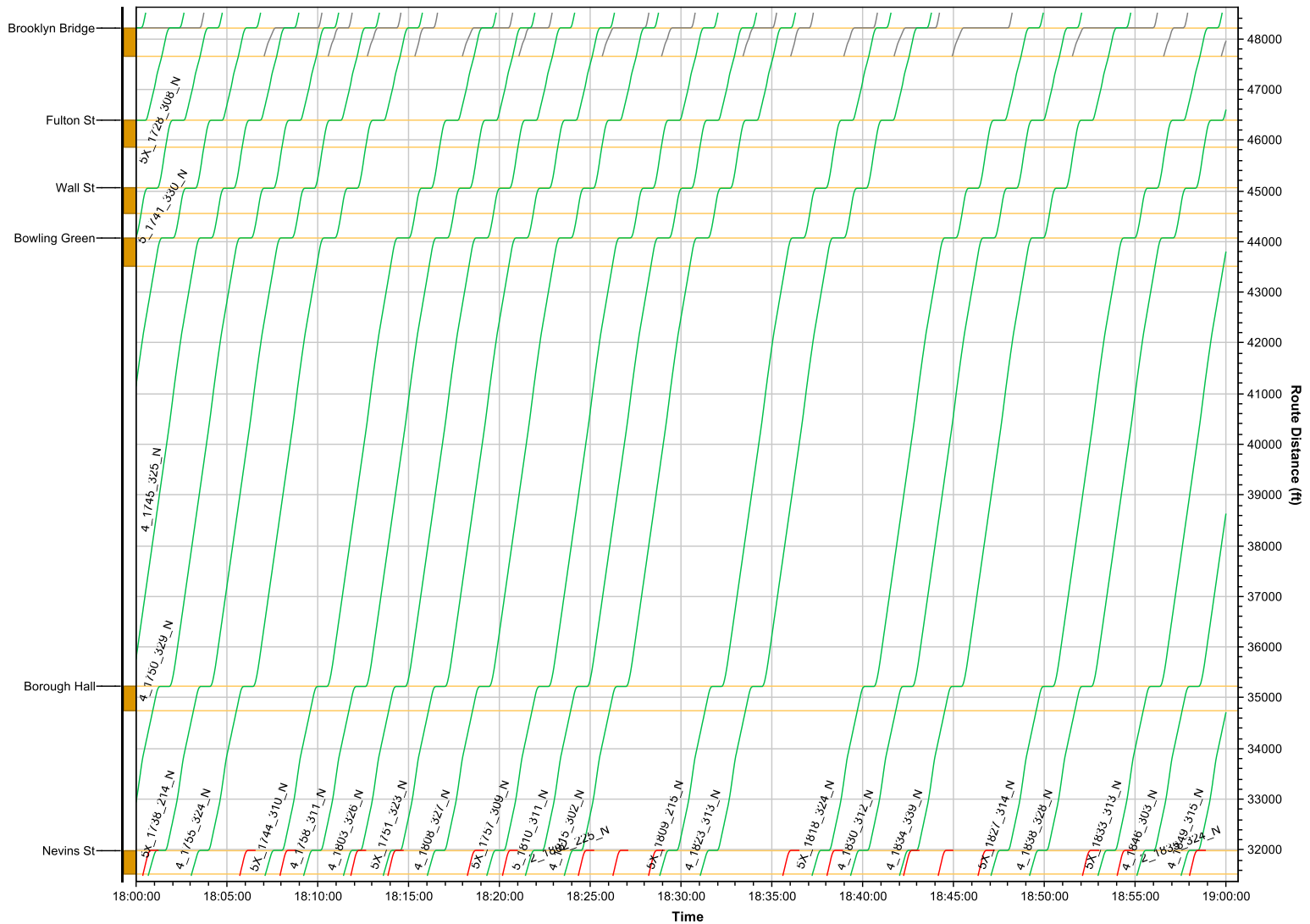
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Figure F.3-23: String Chart - Nevins Street to Brooklyn Bridge - Northbound - 5:00 to 6:00 p.m.



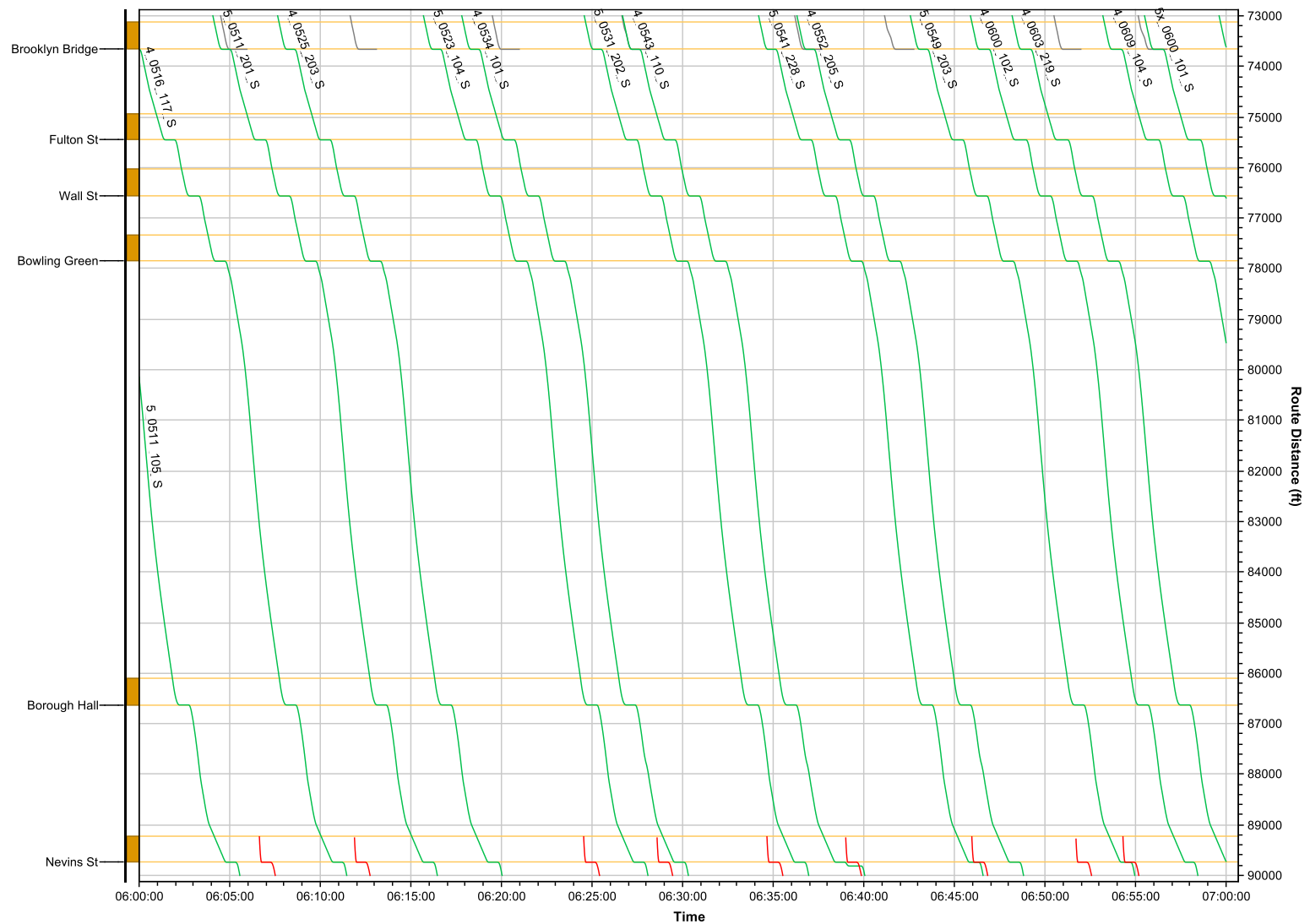
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-24: String Chart - Nevins Street to Brooklyn Bridge - Northbound - 6:00 to 7:00 p.m.



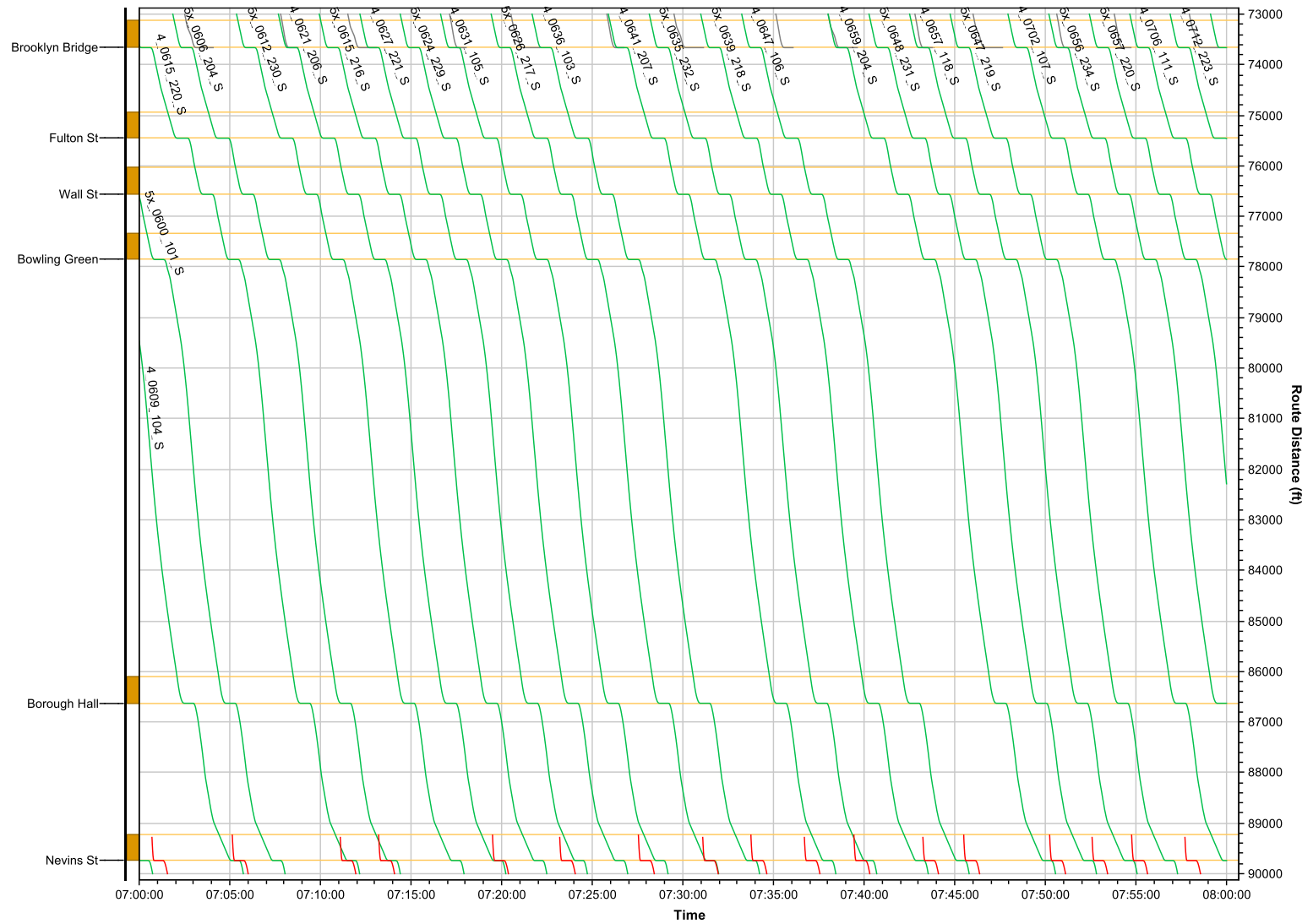
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-25: String Chart - Brooklyn Bridge to Nevins Street - Southbound - 6:00 to 7:00 a.m.



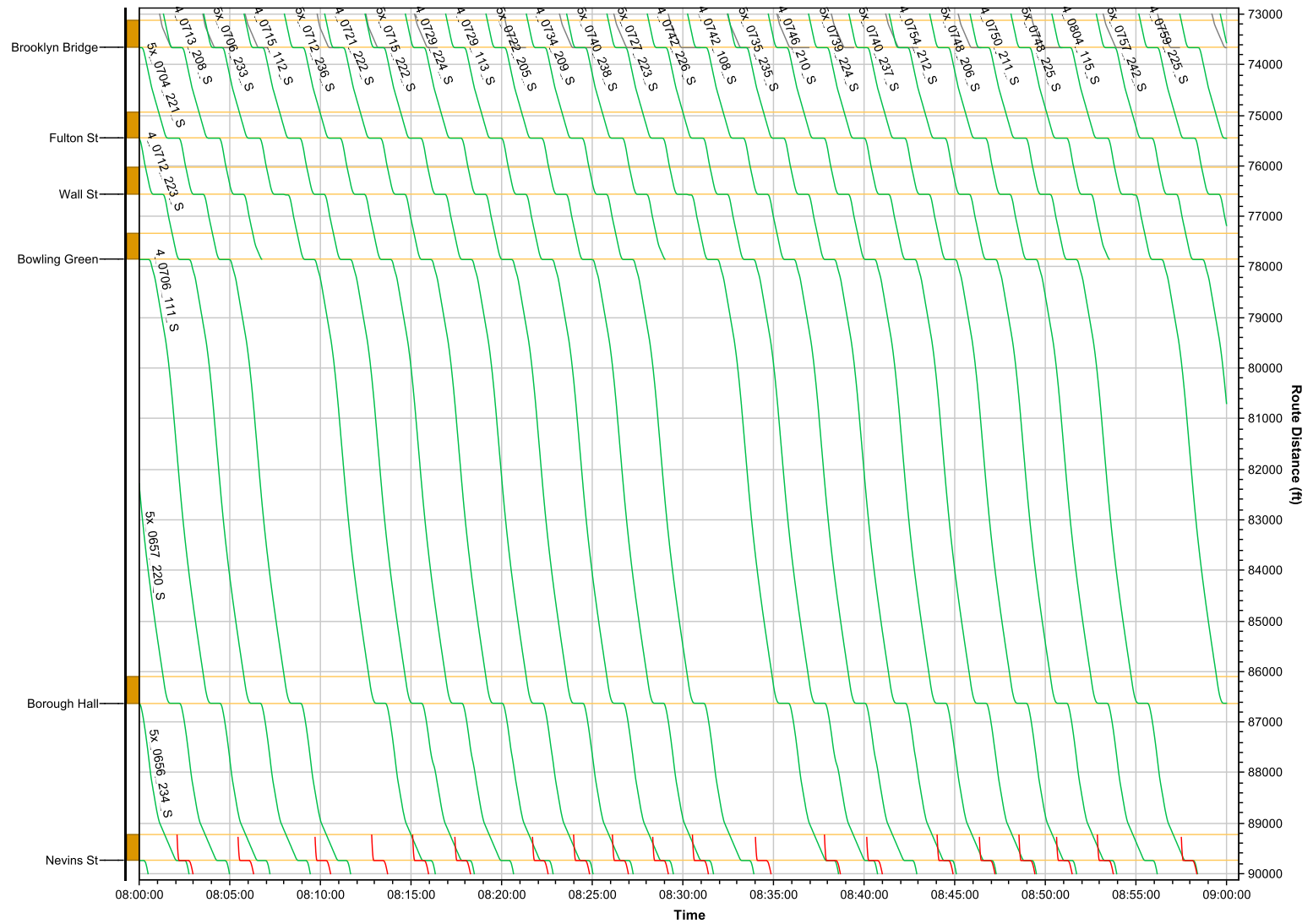
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-26: String Chart - Brooklyn Bridge to Nevins Street - Southbound - 7:00 to 8:00 a.m.



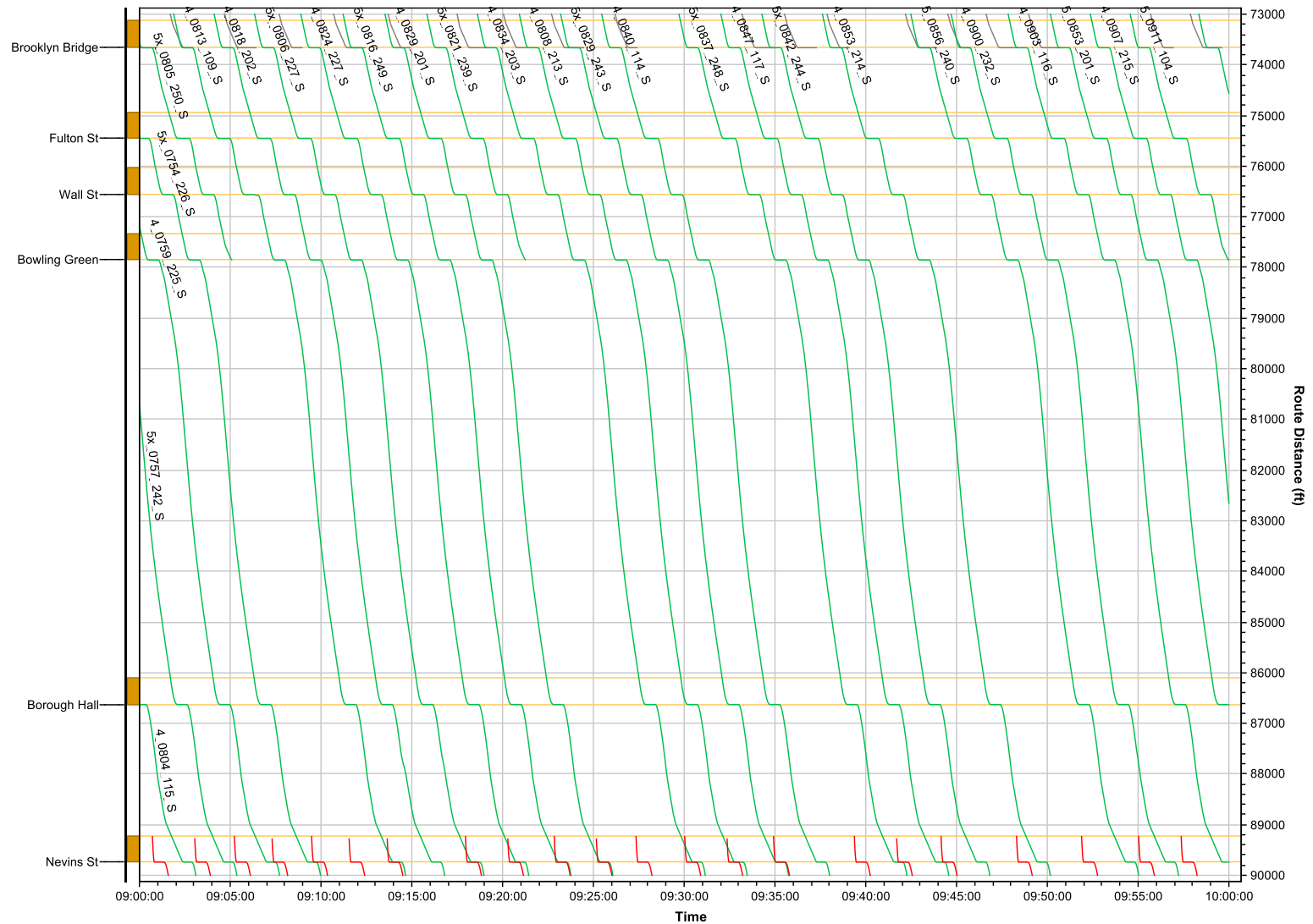
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Figure F.3-27: String Chart - Brooklyn Bridge to Nevins Street - Southbound - 8:00 to 9:00 a.m.



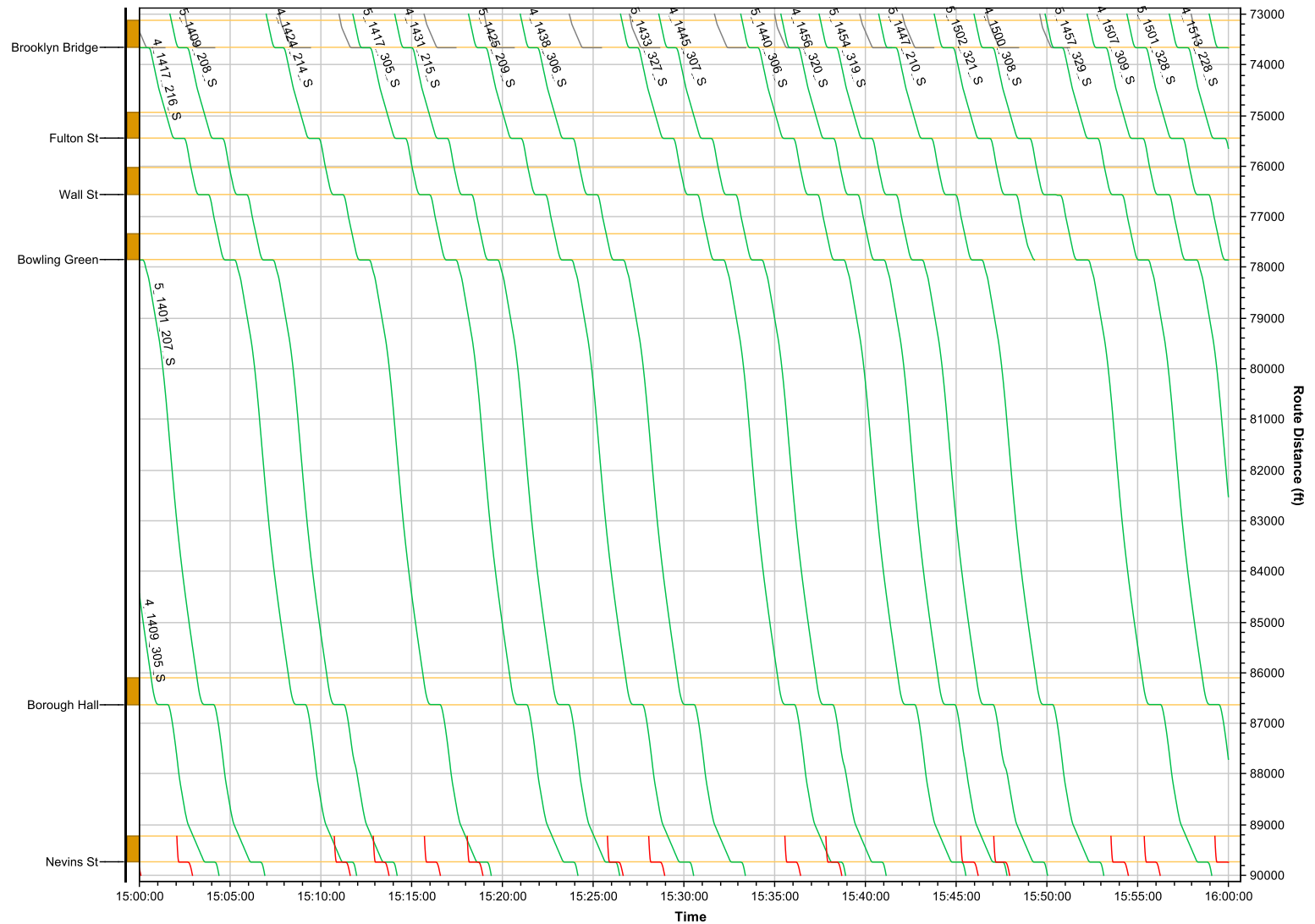
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Figure F.3-28: String Chart - Brooklyn Bridge to Nevins Street - Southbound - 9:00 to 10:00 a.m.



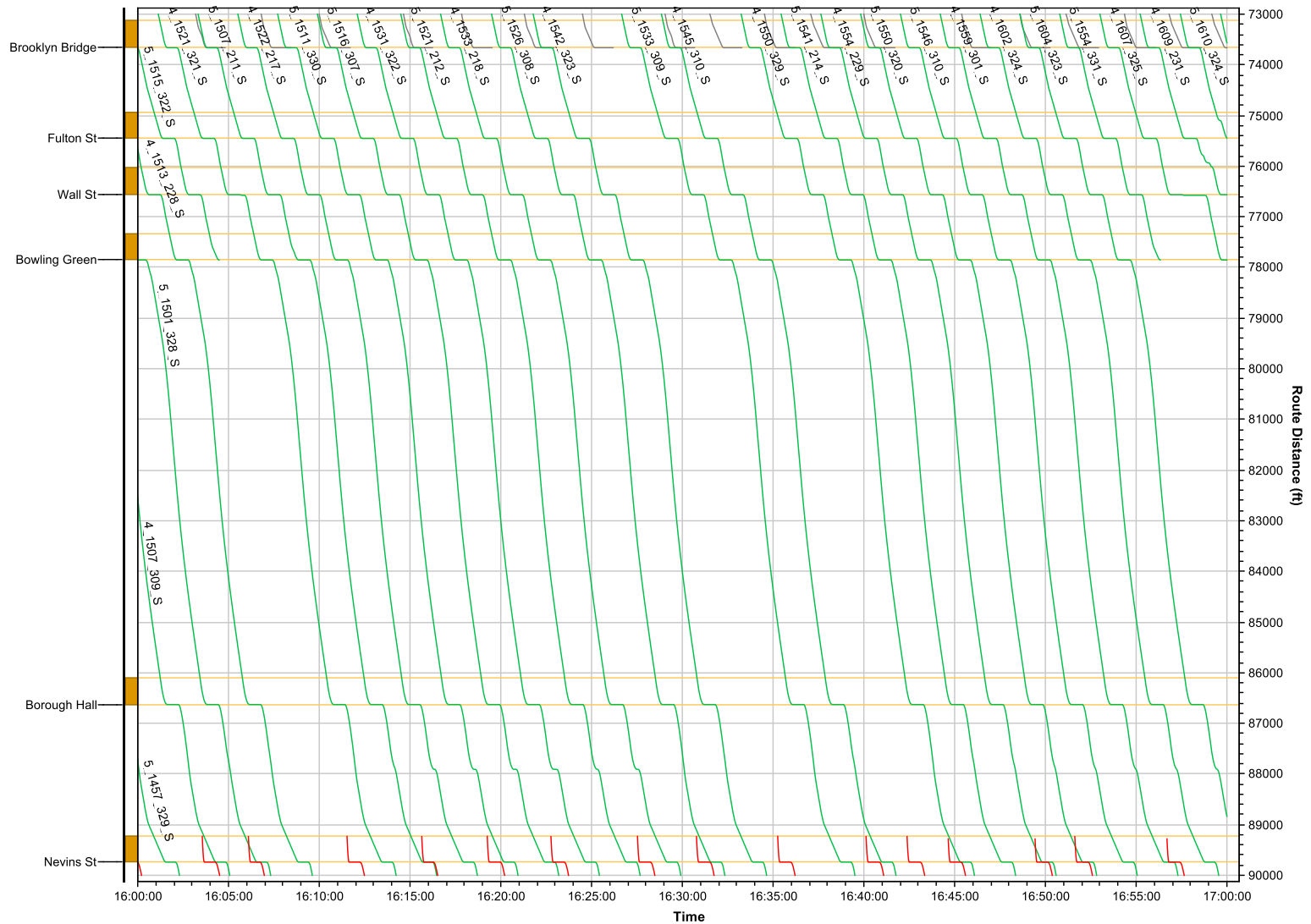
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-29: String Chart - Brooklyn Bridge to Nevins Street - Southbound - 3:00 to 4:00 p.m.



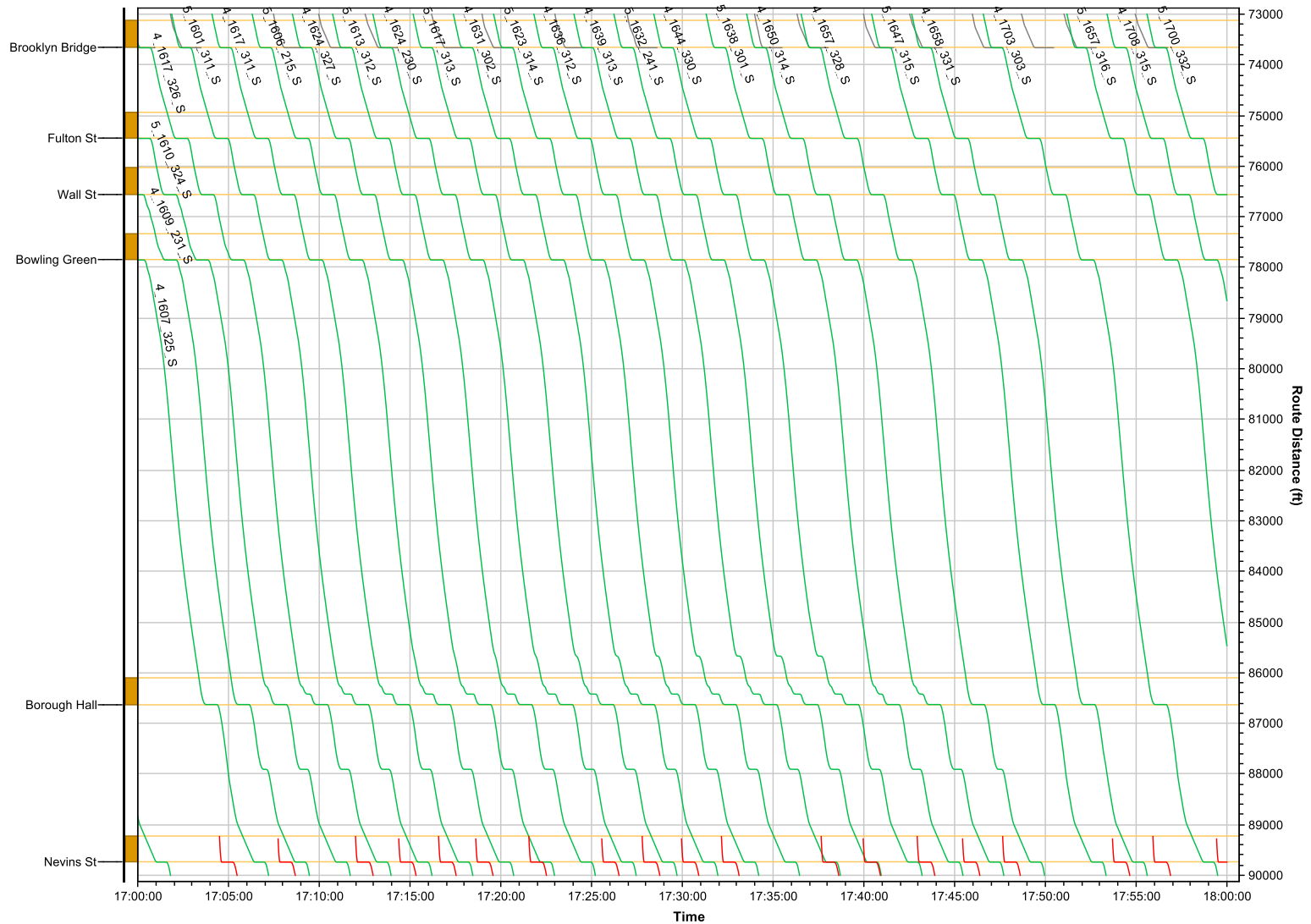
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Figure F.3-30: String Chart - Brooklyn Bridge to Nevins Street Southbound - 4:00 to 5:00 p.m.



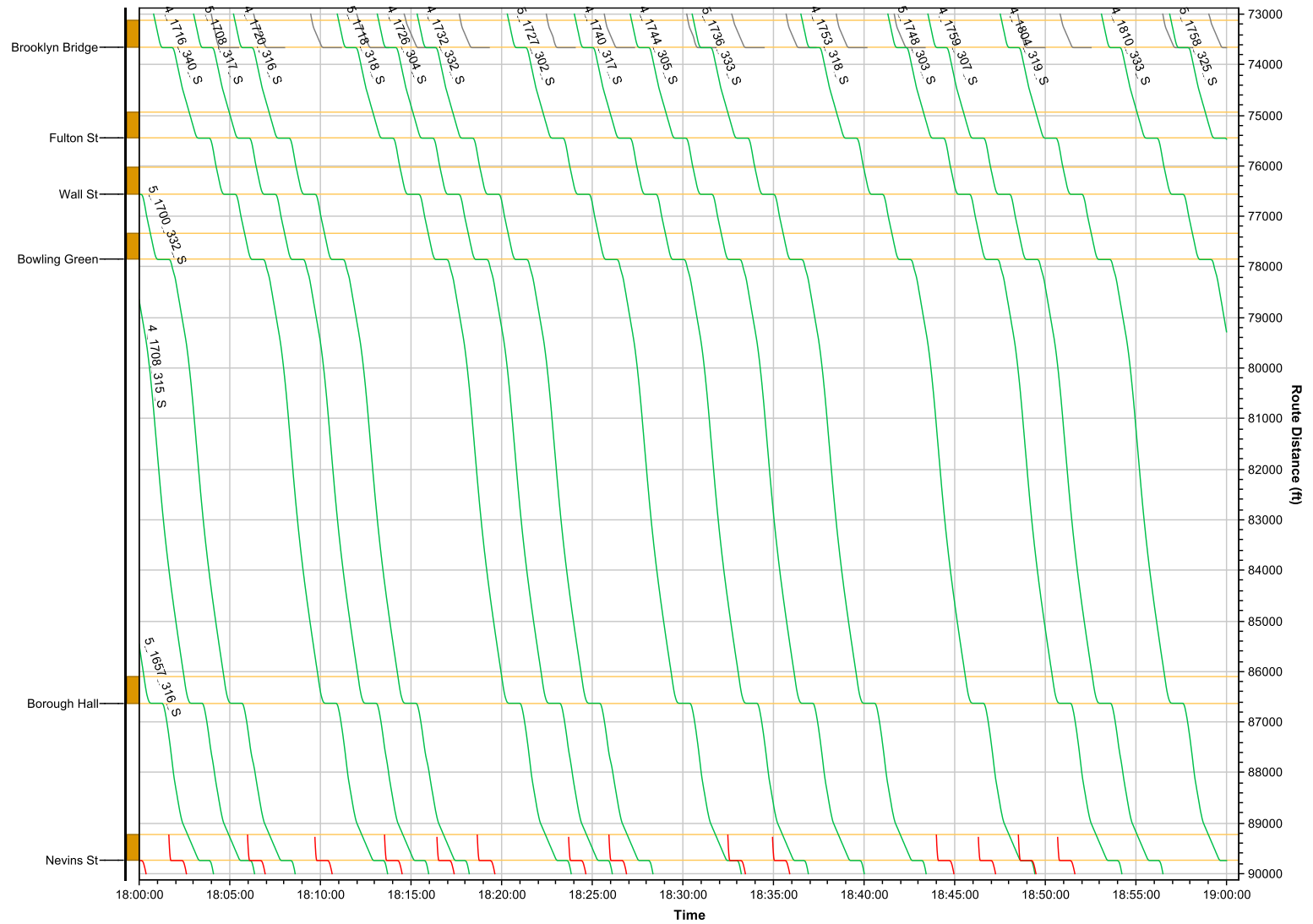
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Figure F.3-31: String Chart - Brooklyn Bridge to Nevins Street - Southbound - 5:00 to 6:00 p.m.



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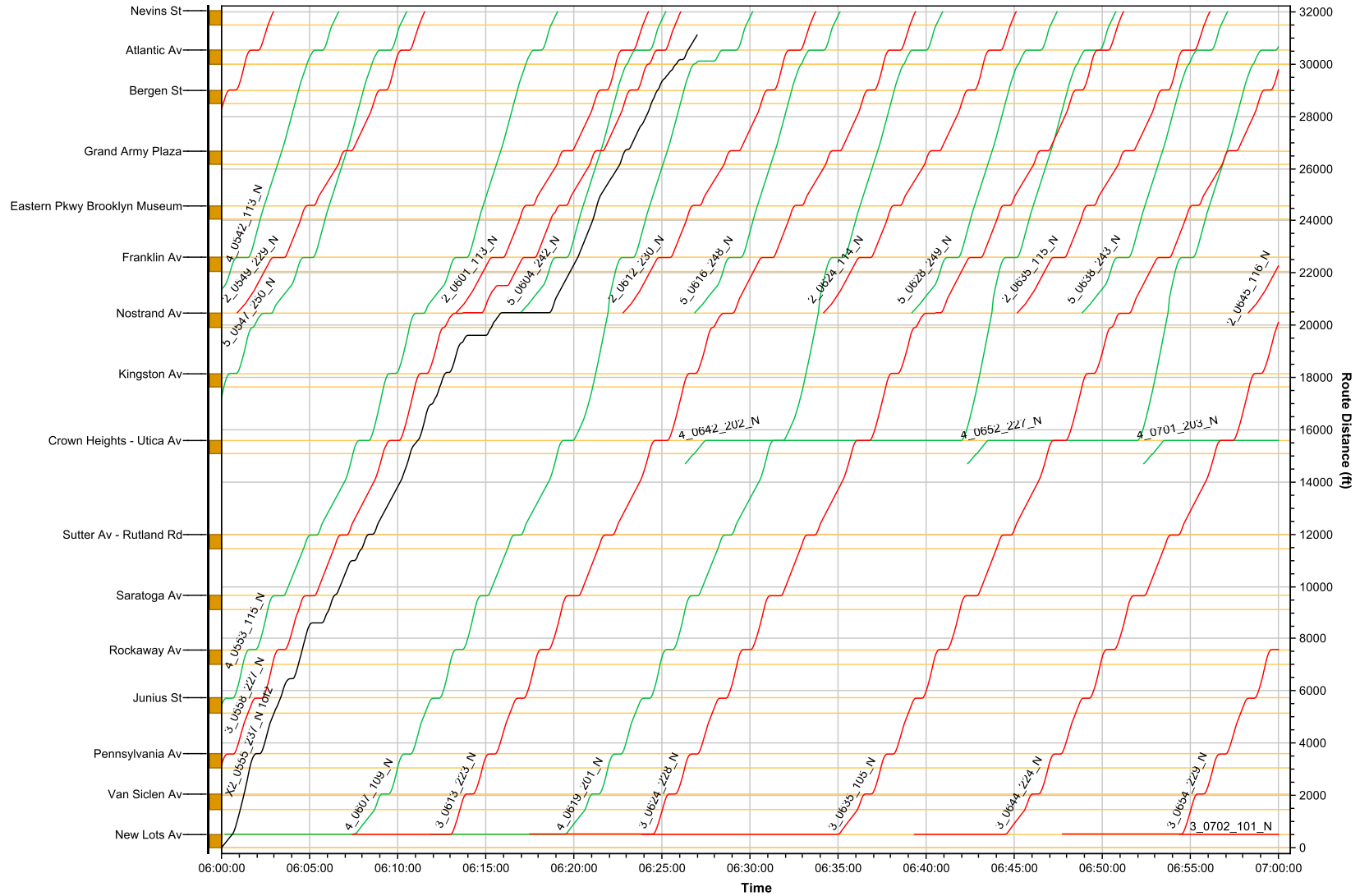
Figure F.3-32: String Chart - Brooklyn Bridge to Nevins Street - Southbound - 6:00 to 7:00 p.m.



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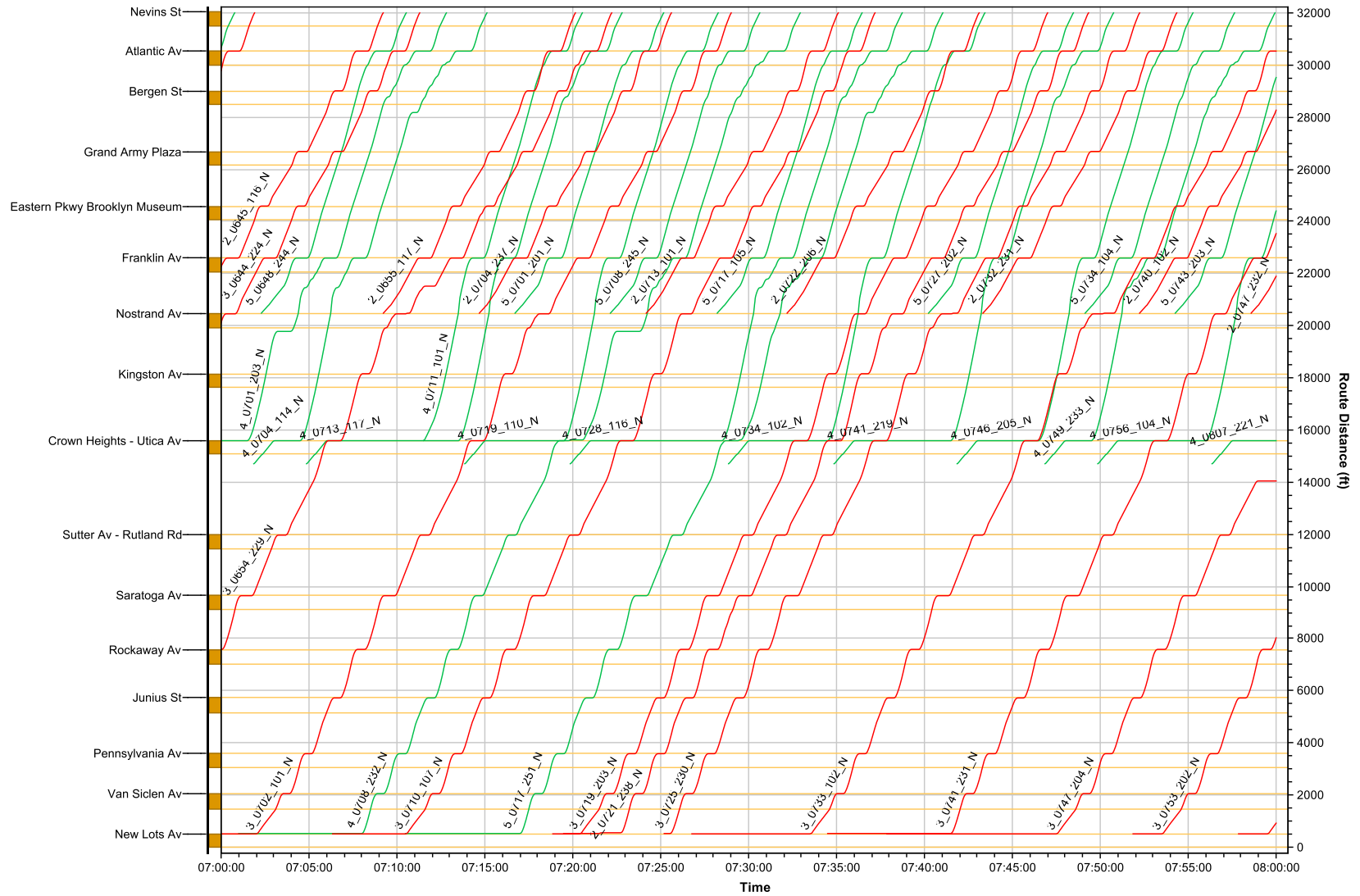
F.3.3 Nevins Street to New Lots Avenue

Figure F.3-33: String Chart - New Lots Avenue to Nevins Street – Northbound - 6:00 to 7:00 a.m.



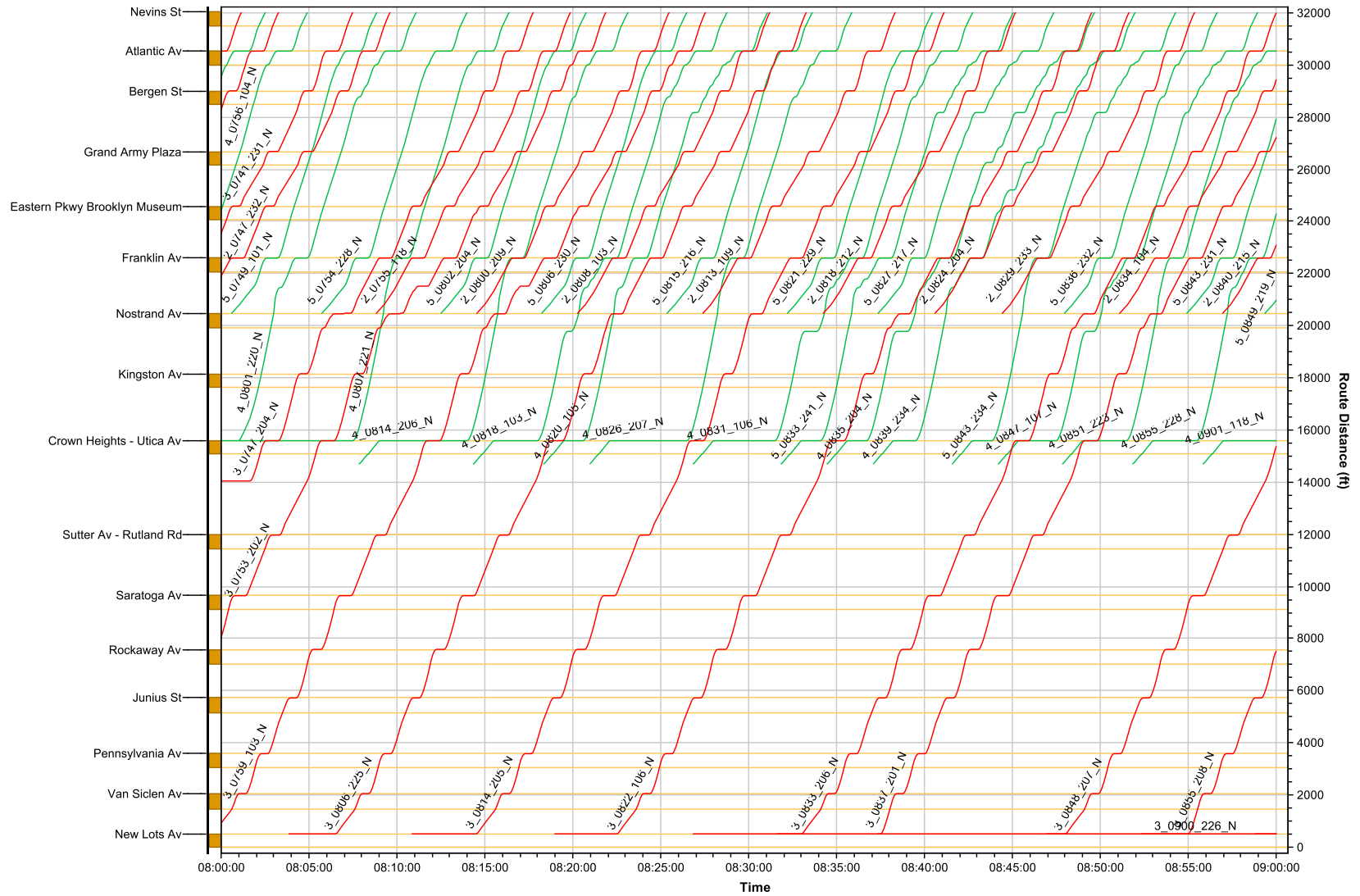
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Figure F.3-34: String Chart - New Lots Avenue to Nevins Street – Northbound - 7:00 to 8:00 a.m.



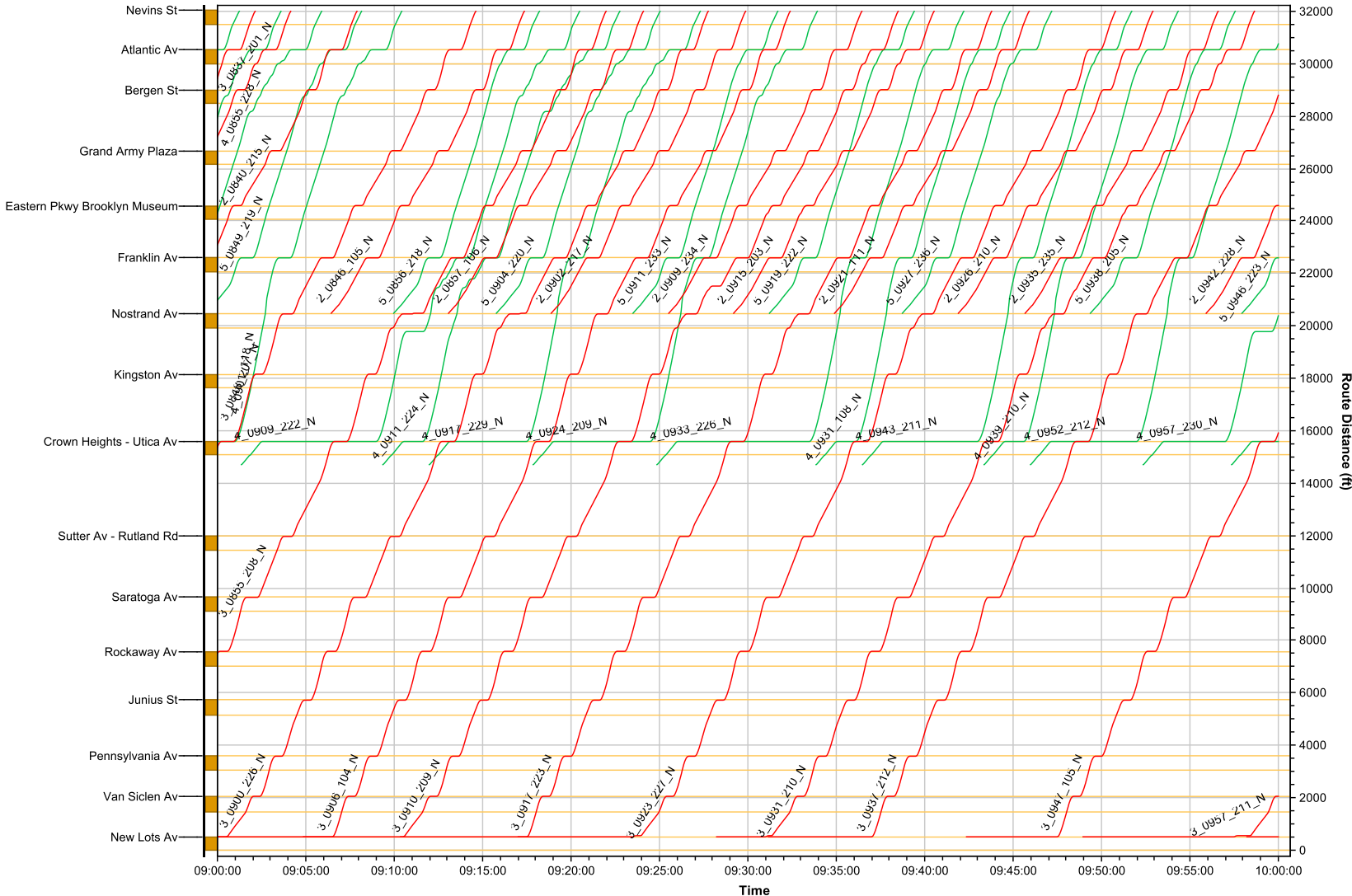
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Figure F.3-35: String Chart - New Lots Avenue to Nevins Street – Northbound - 8:00 to 9:00 a.m.



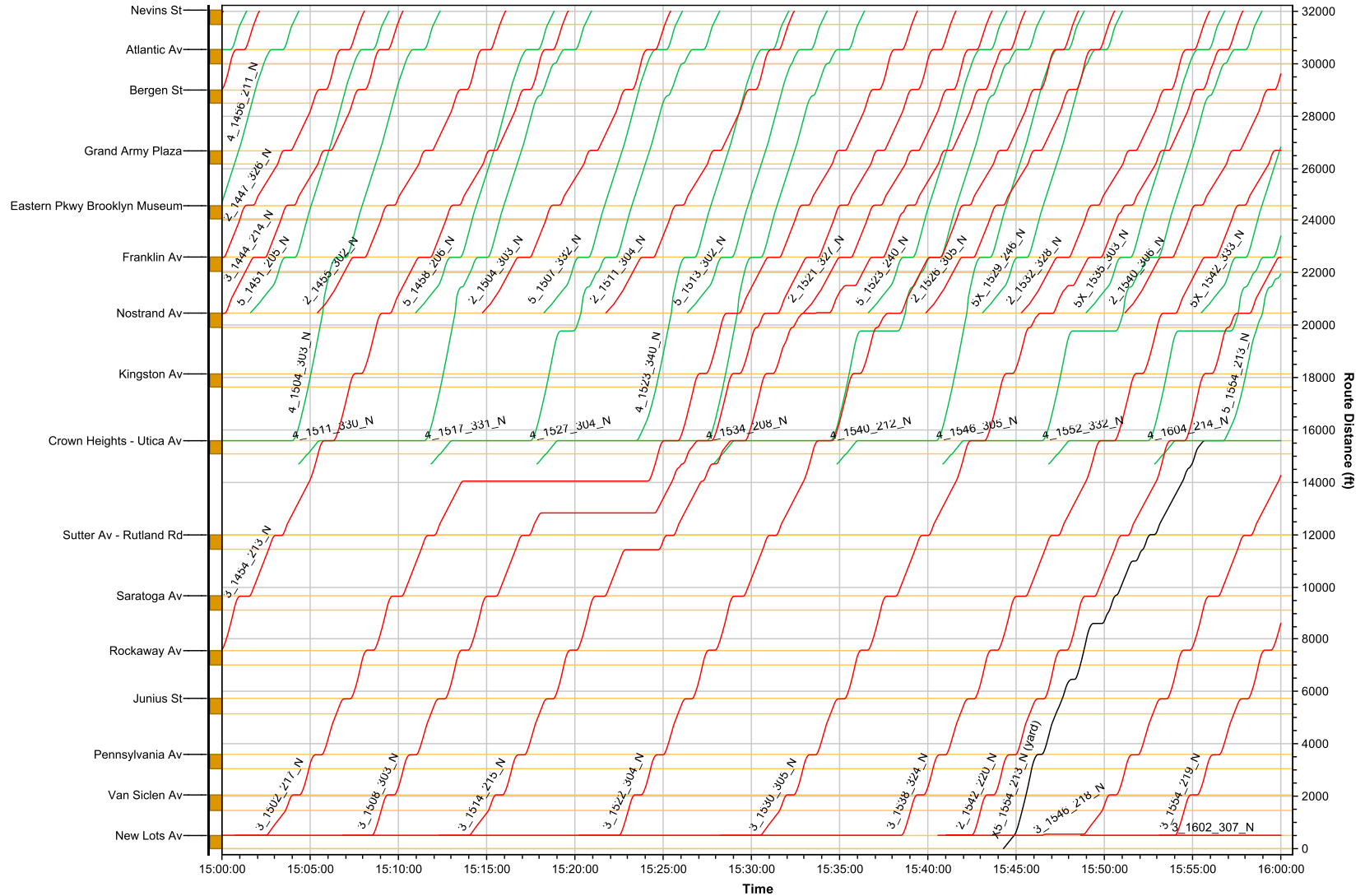
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Figure F.3-36: String Chart - New Lots Avenue to Nevins Street – Northbound - 9:00 to 10:00 a.m.



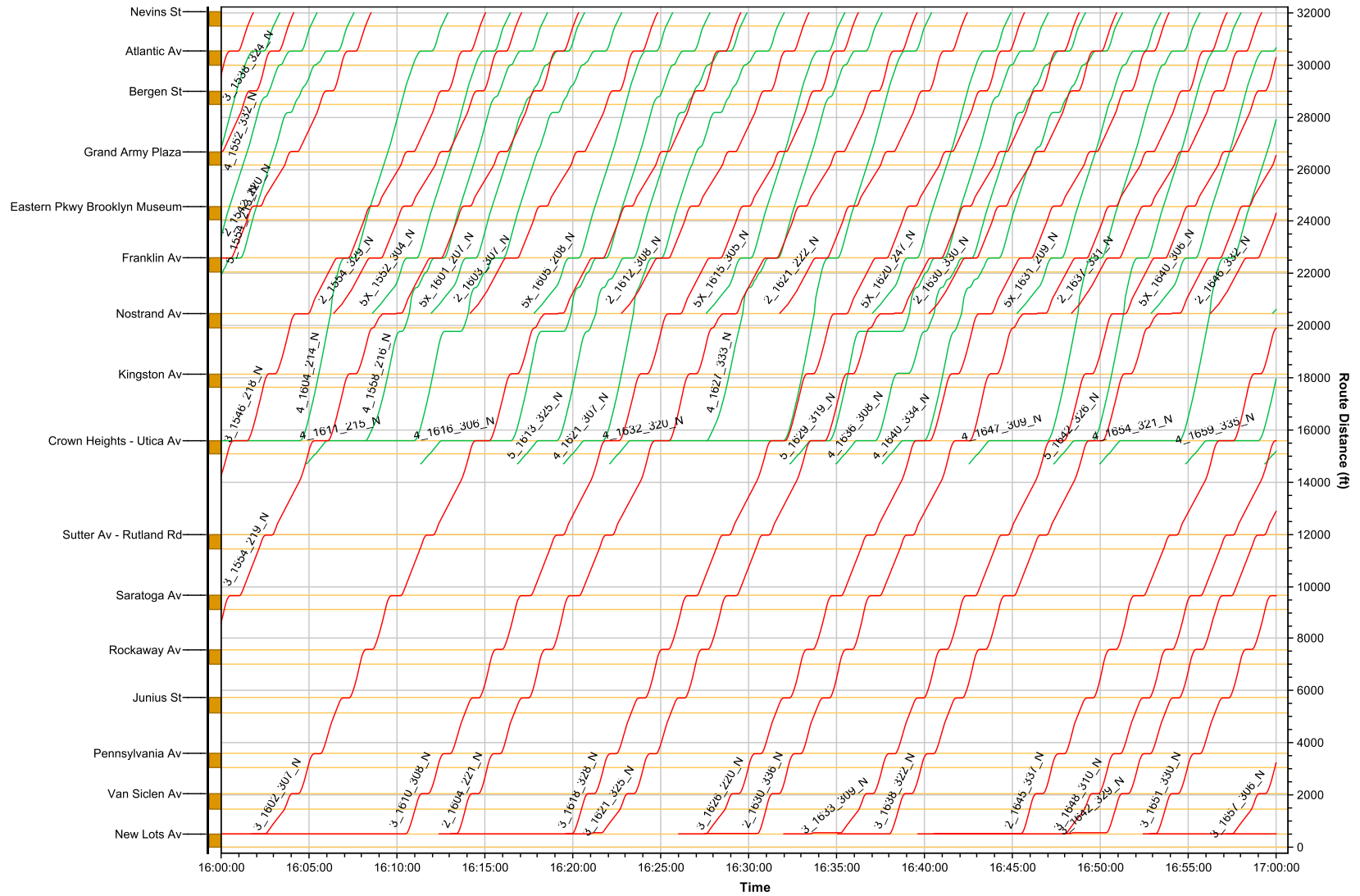
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Figure F.3-37: String Chart - New Lots Avenue to Nevins Street – Northbound - 3:00 to 4:00 p.m.



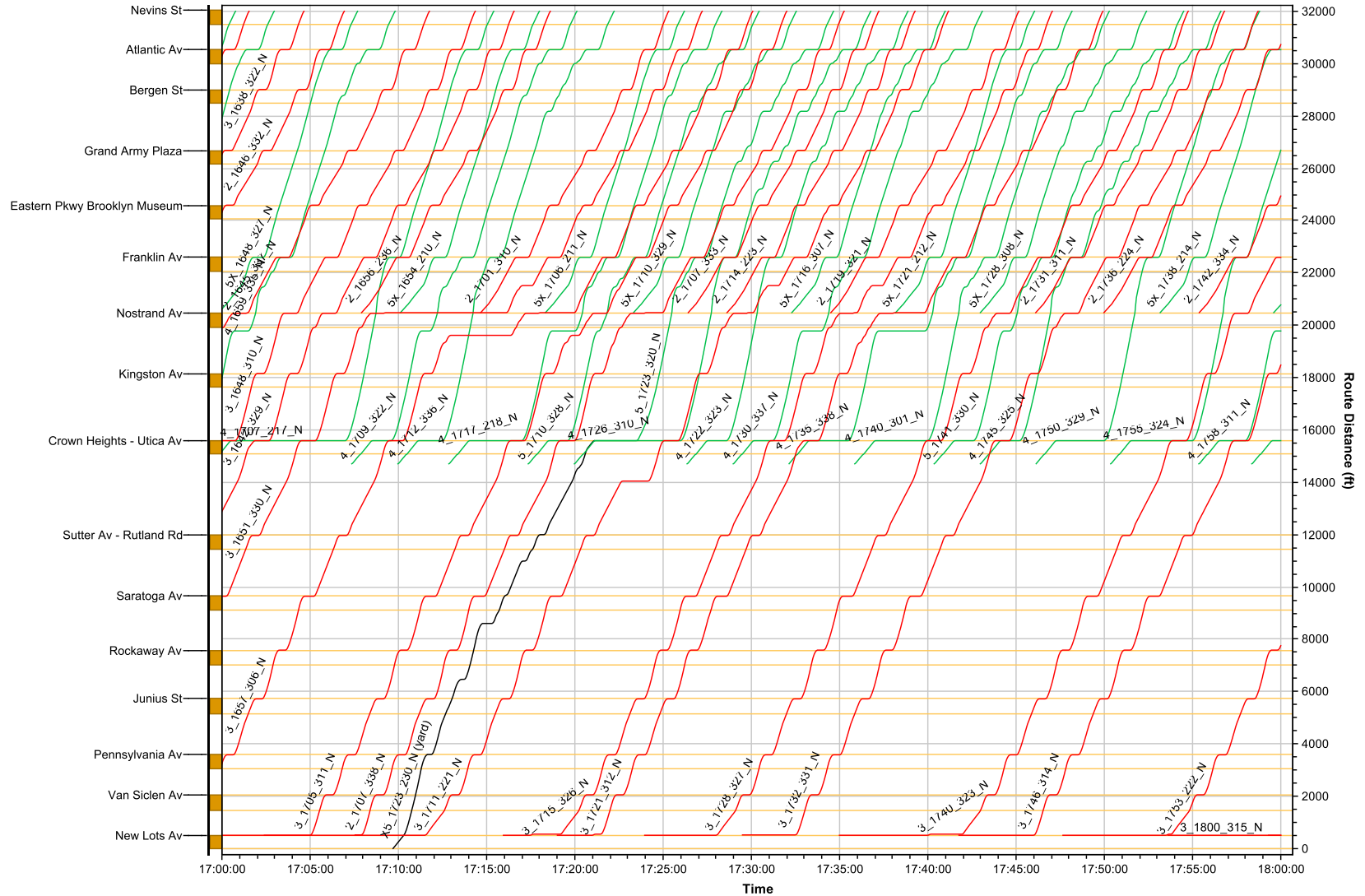
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Figure F.3-38: String Chart - New Lots Avenue to Nevins Street – Northbound - 4:00 to 5:00 p.m.



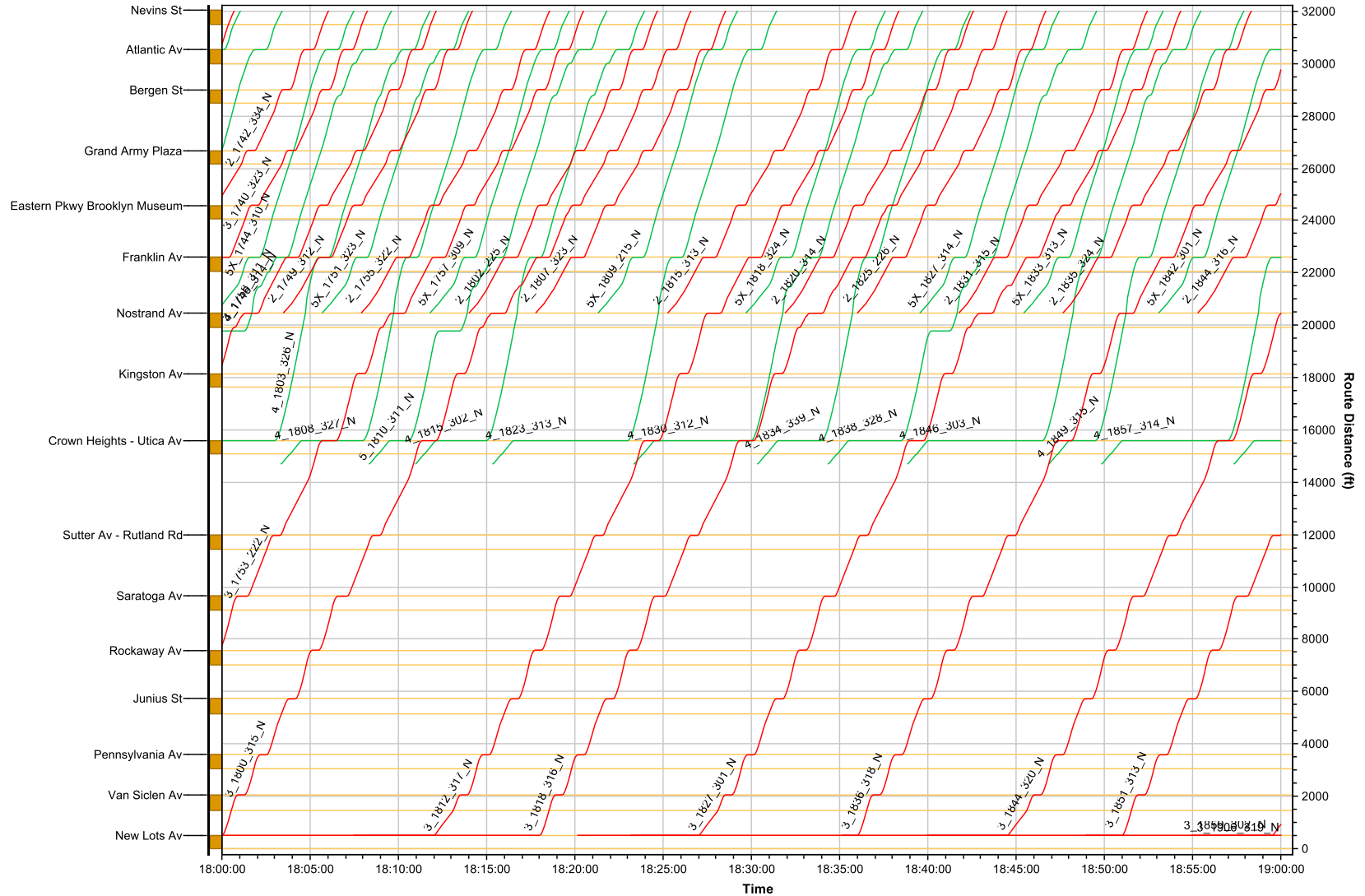
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Figure F.3-39: String Chart - New Lots Avenue to Nevins Street – Northbound - 5:00 to 6:00 p.m.



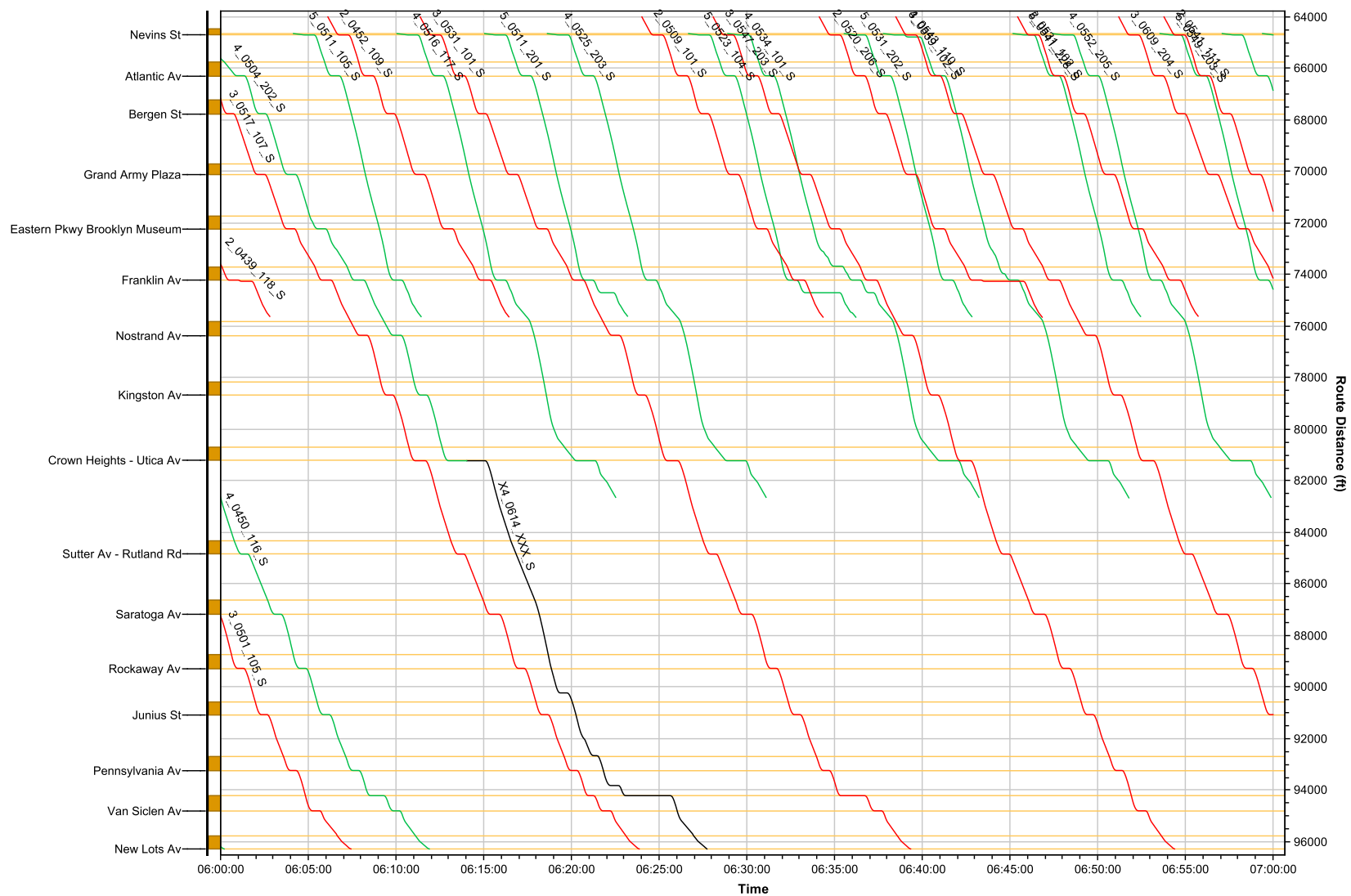
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Figure F.3-40: String Chart - New Lots Avenue to Nevins Street – Northbound - 6:00 to 7:00 p.m.



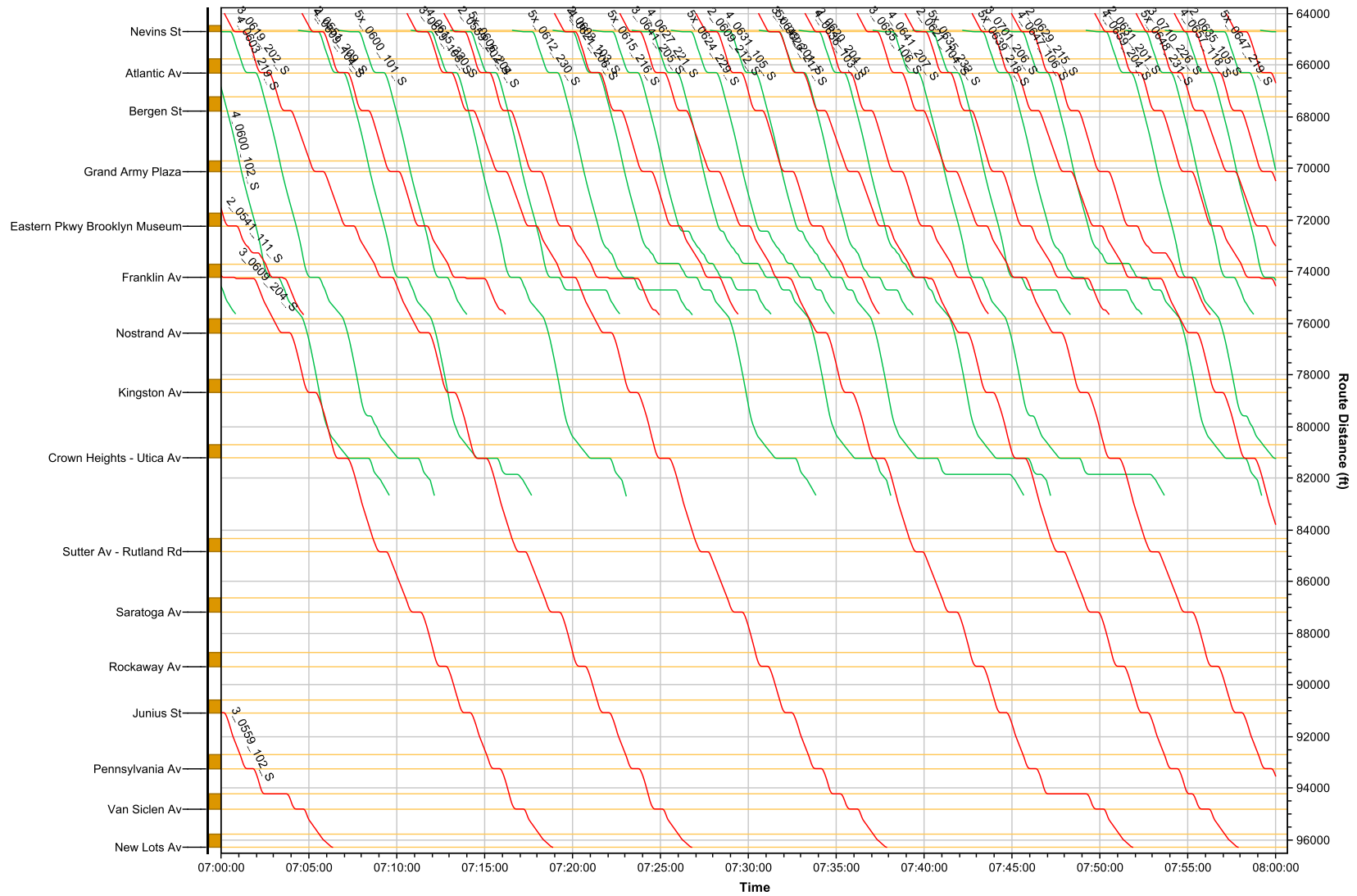
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Figure F.3-41: String Chart - Nevins Street to New Lots Avenue - Southbound - 6:00 to 7:00 a.m.



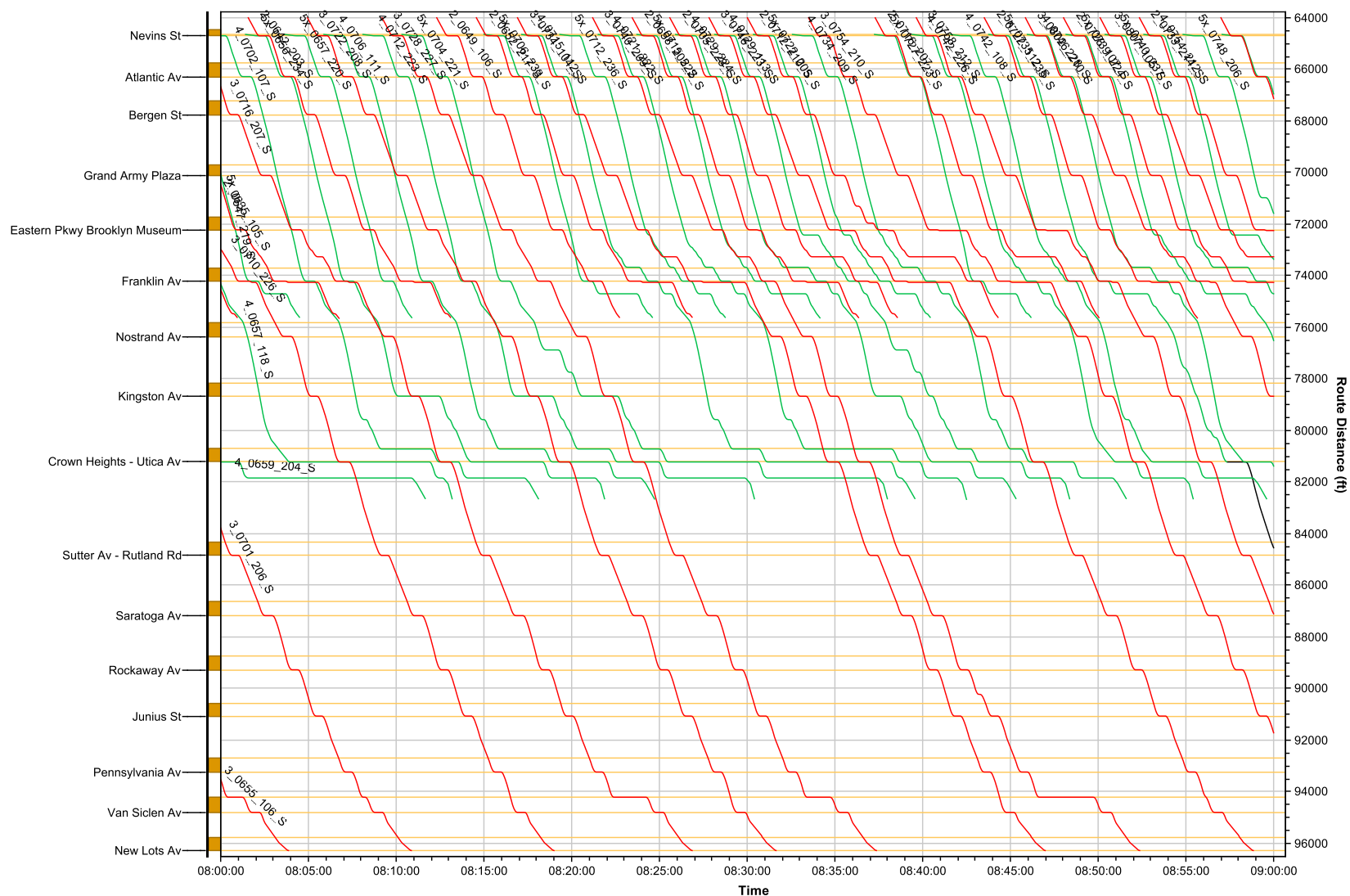
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Figure F.3-42: String Chart - Nevins Street to New Lots Avenue - Southbound - 7:00 to 8:00 a.m.



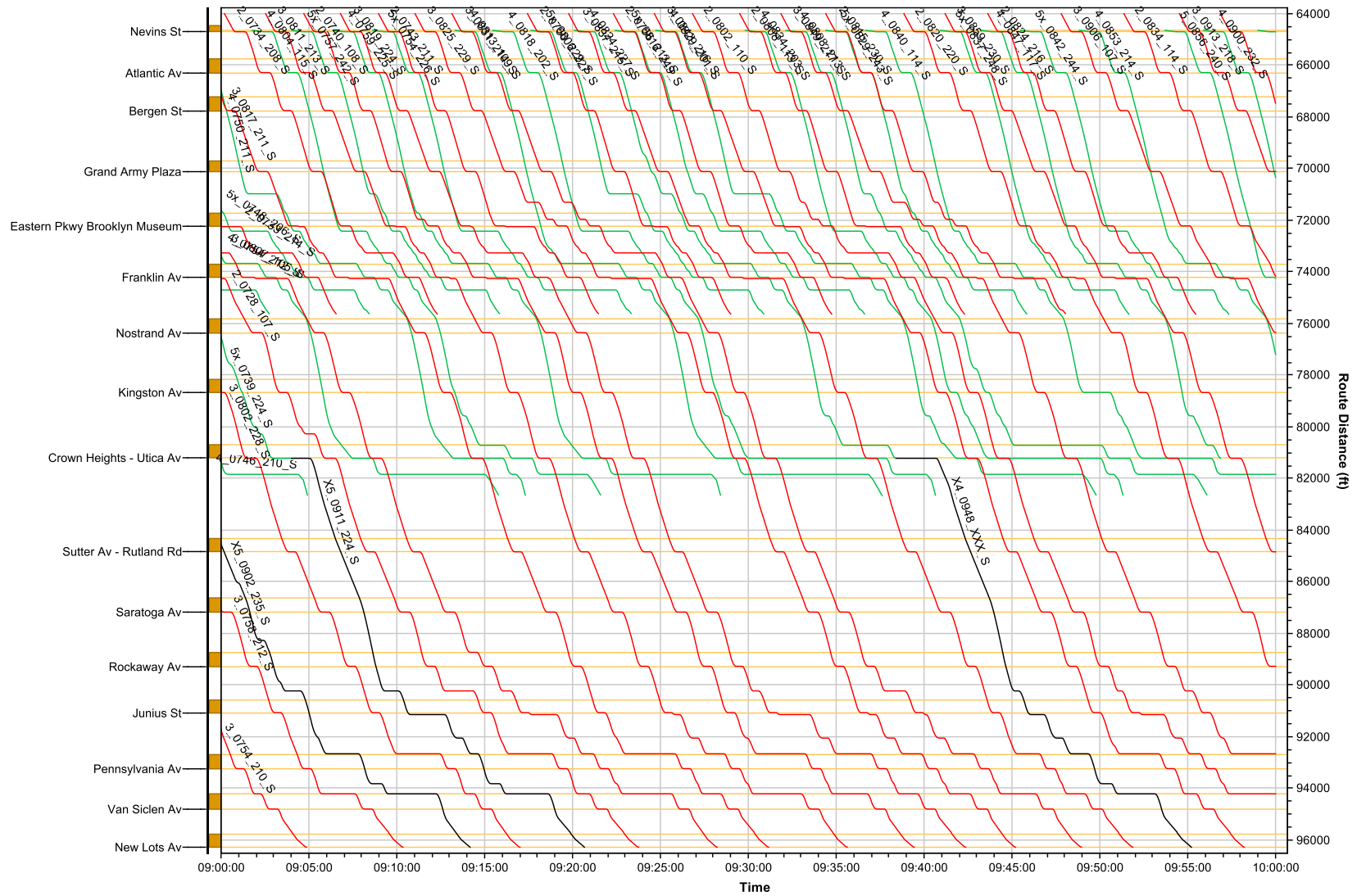
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Figure F.3-43: String Chart - Nevins Street to New Lots Avenue - Southbound - 8:00 to 9:00 a.m.



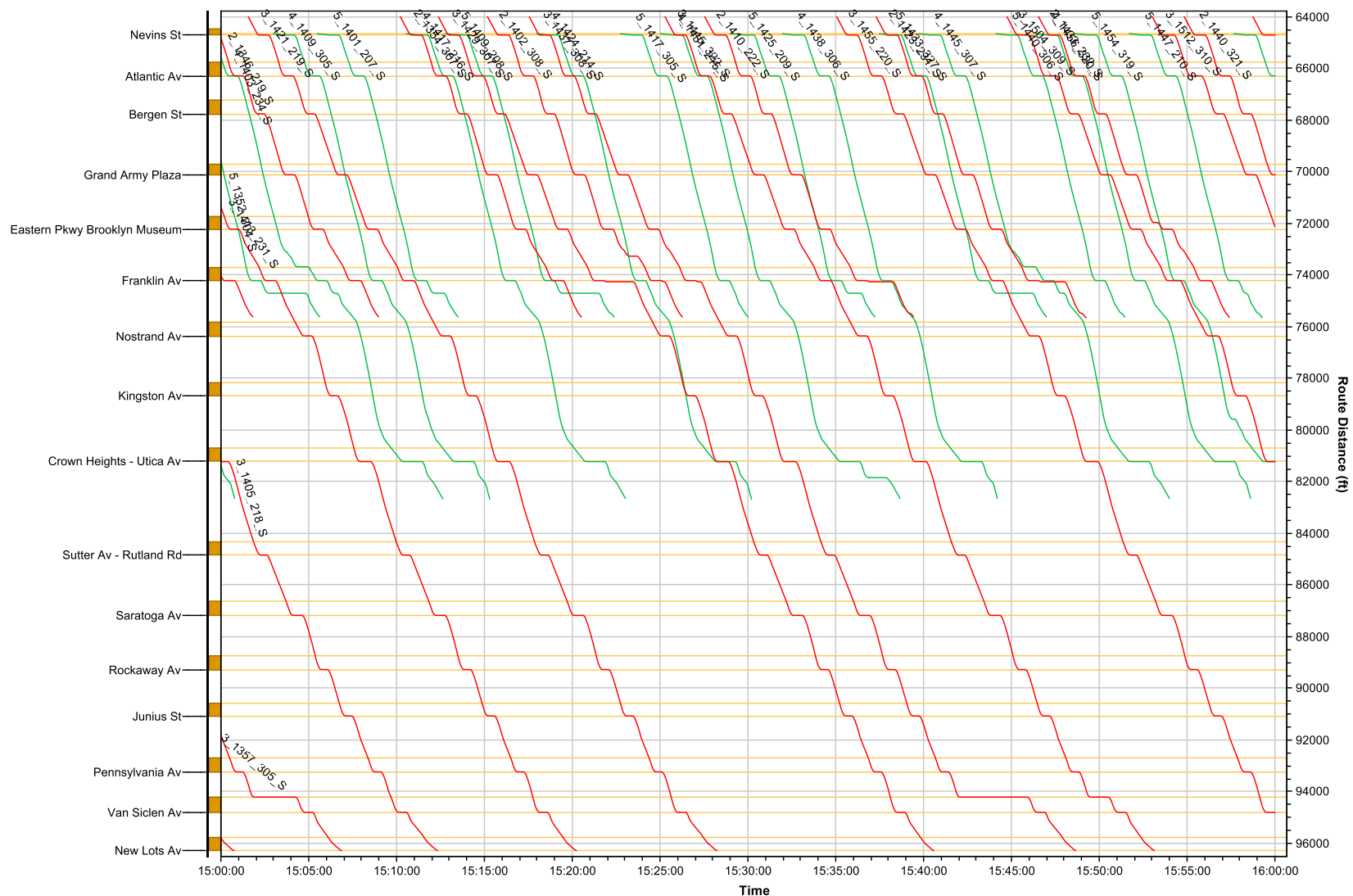
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-44: String Chart - Nevins Street to New Lots Avenue - Southbound - 9:00 to 10:00 a.m.



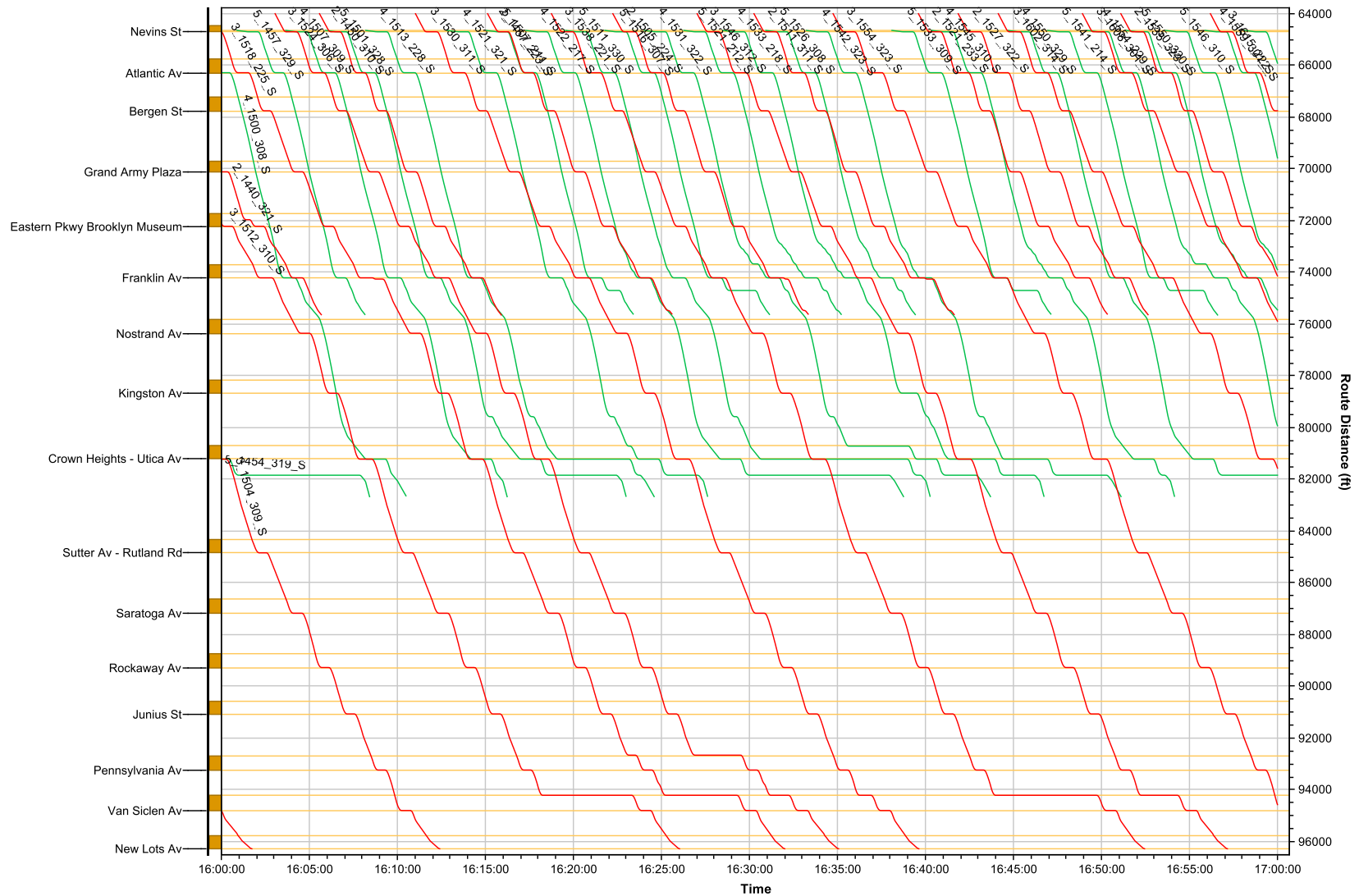
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Figure F.3-45: String Chart - Nevins Street to New Lots Avenue - Southbound - 3:00 to 4:00 p.m.



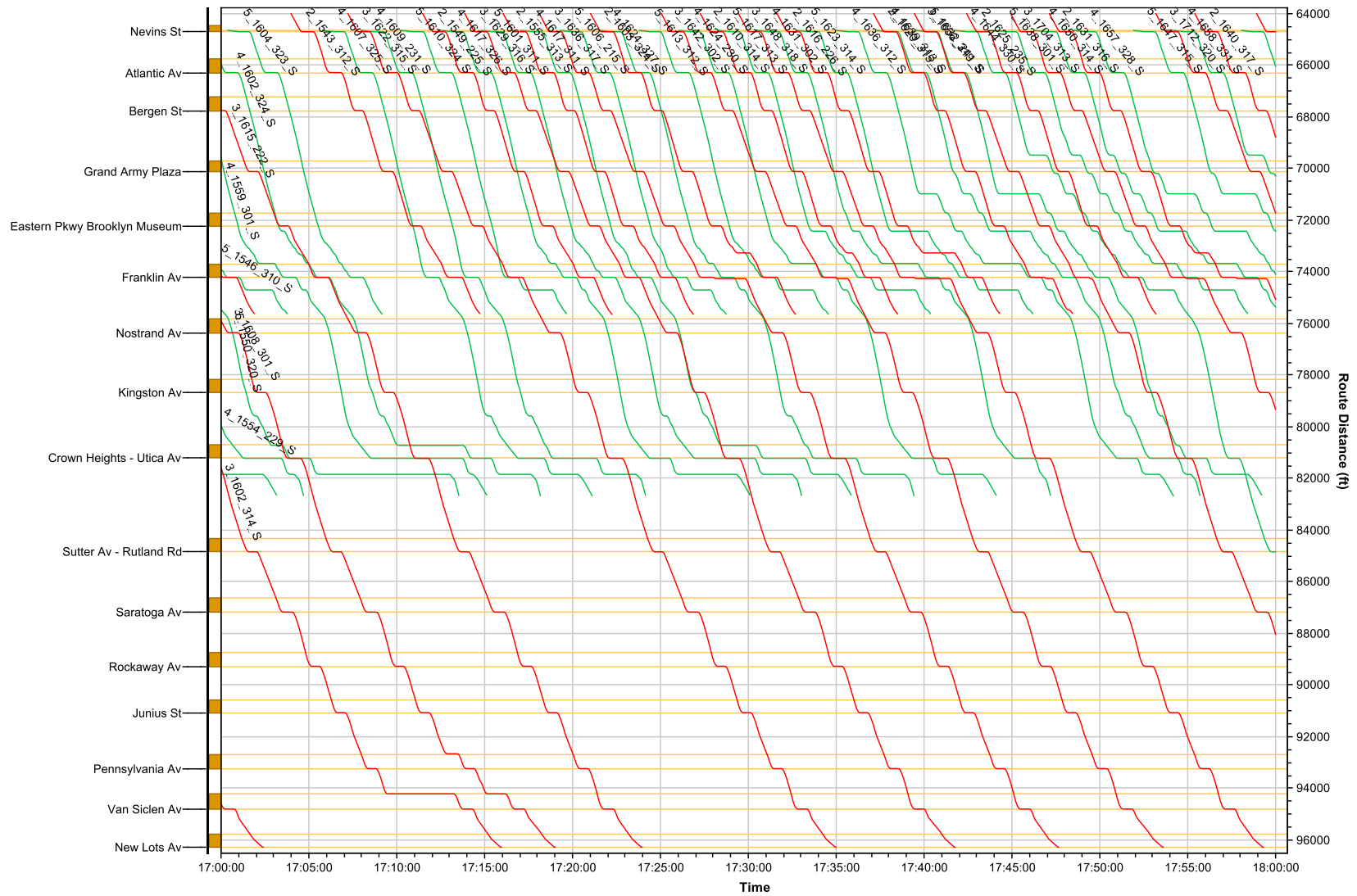
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Figure F.3-46: String Chart - Nevins Street to New Lots Avenue - Southbound - 4:00 to 5:00 p.m.



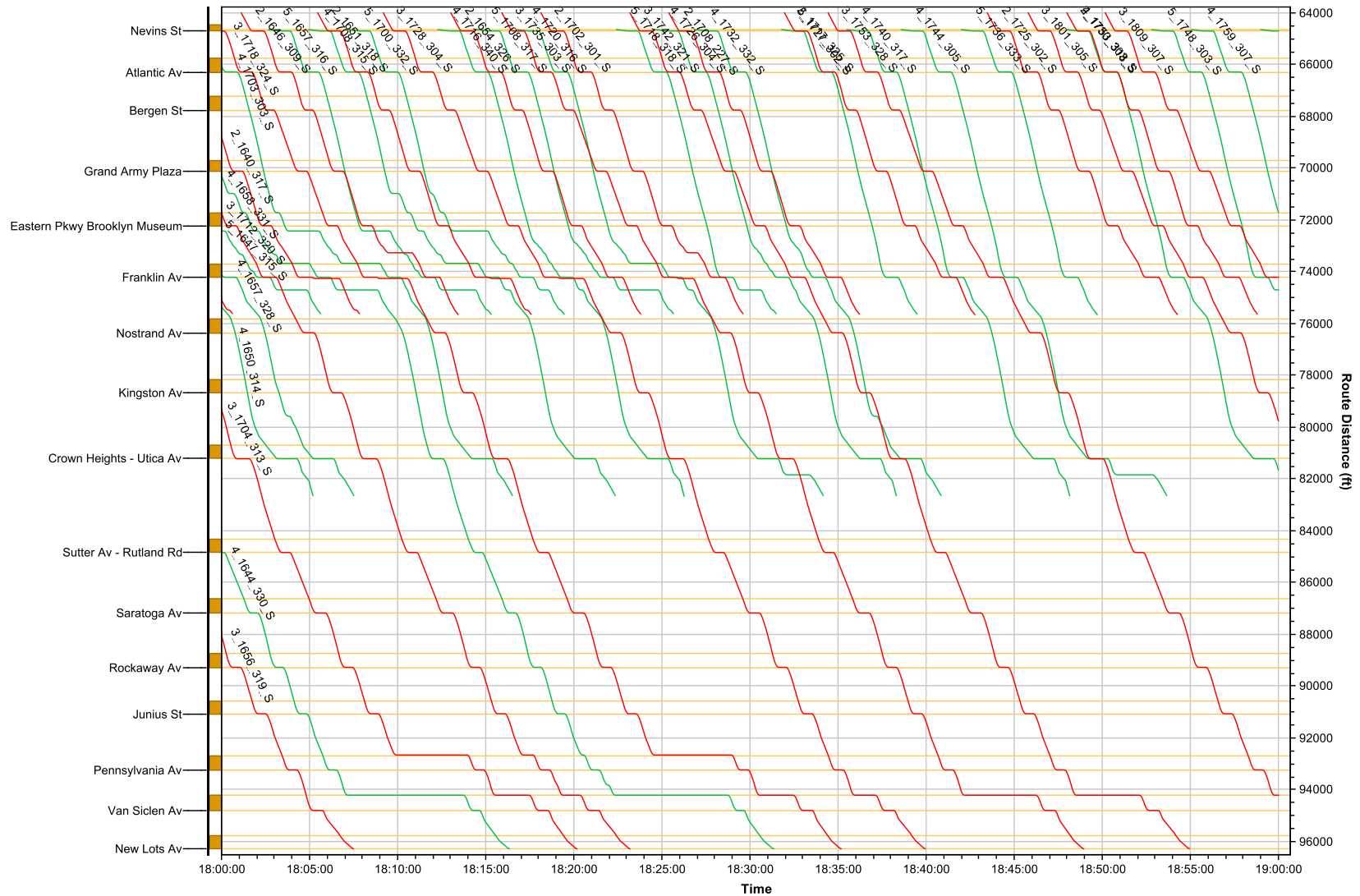
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Figure F.3-47: String Chart - Nevins Street to New Lots Avenue - Southbound - 5:00 to 6:00 p.m.



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Figure F.3-48: String Chart - Nevins Street to New Lots Avenue - Southbound - 6:00 to 7:00 p.m.



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F.3.4 Nevins Street to Flatbush Avenue-Brooklyn College

Figure F.3-49: String Chart - Flatbush Avenue-Brooklyn College to Nevins Street - Northbound - 6:00 to 7:00 a.m.

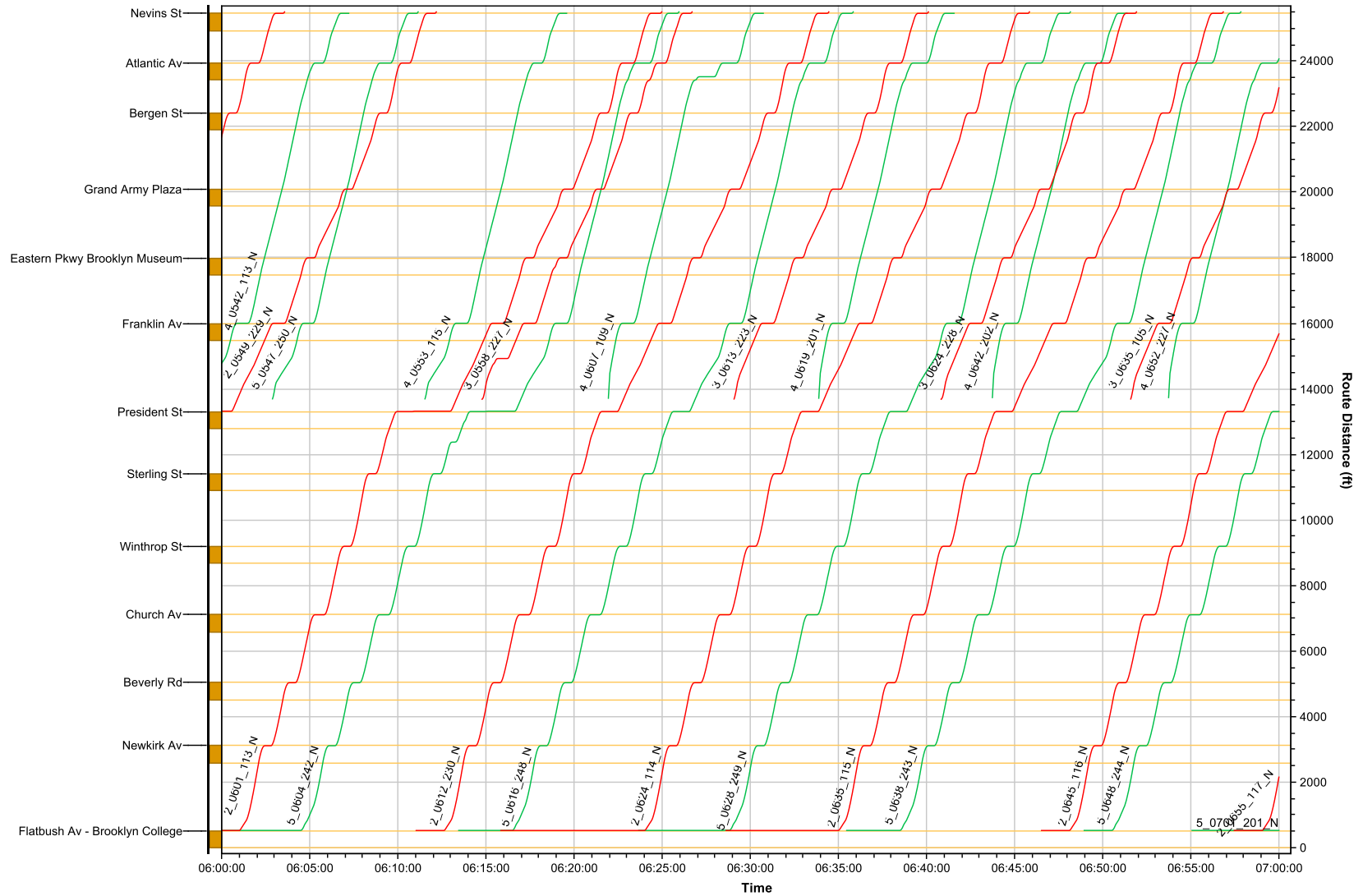
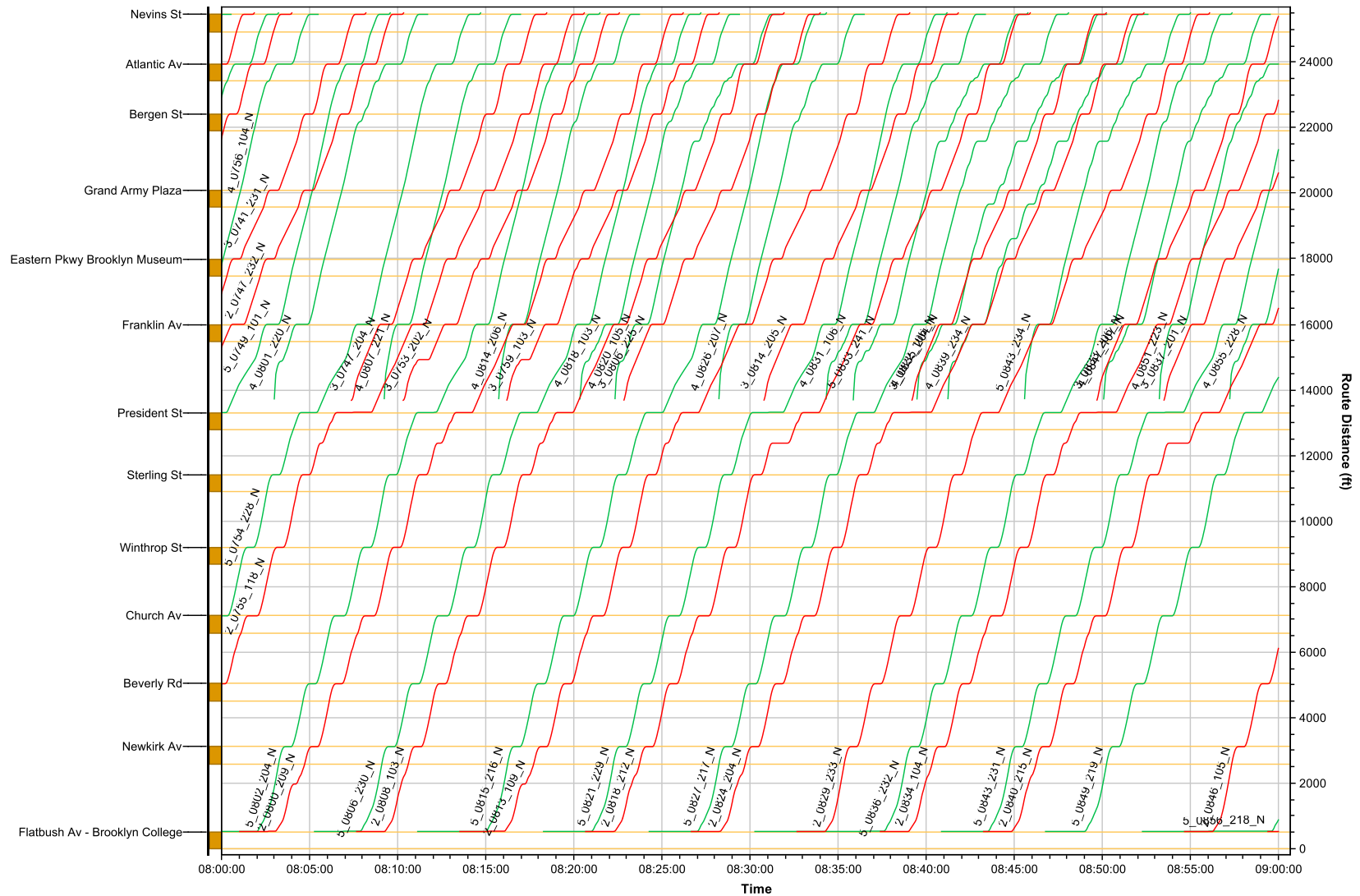


Figure F.3-50: String Chart - Flatbush Avenue-Brooklyn College to Nevins Street - Northbound - 7:00 to 8:00 a.m.



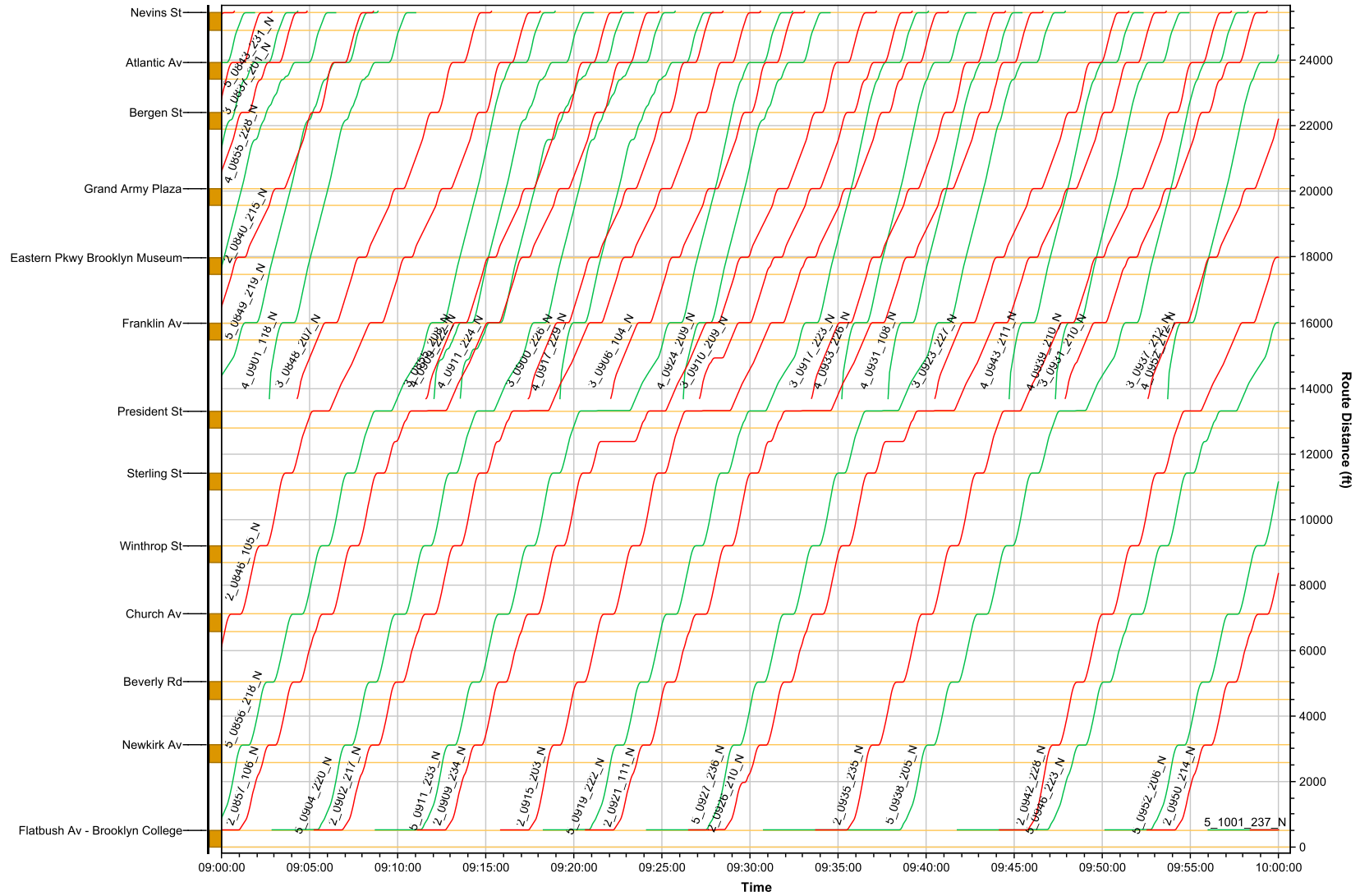
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Figure F.3-51: String Chart - Flatbush Avenue-Brooklyn College to Nevins Street - Northbound - 8:00 to 9:00 a.m.



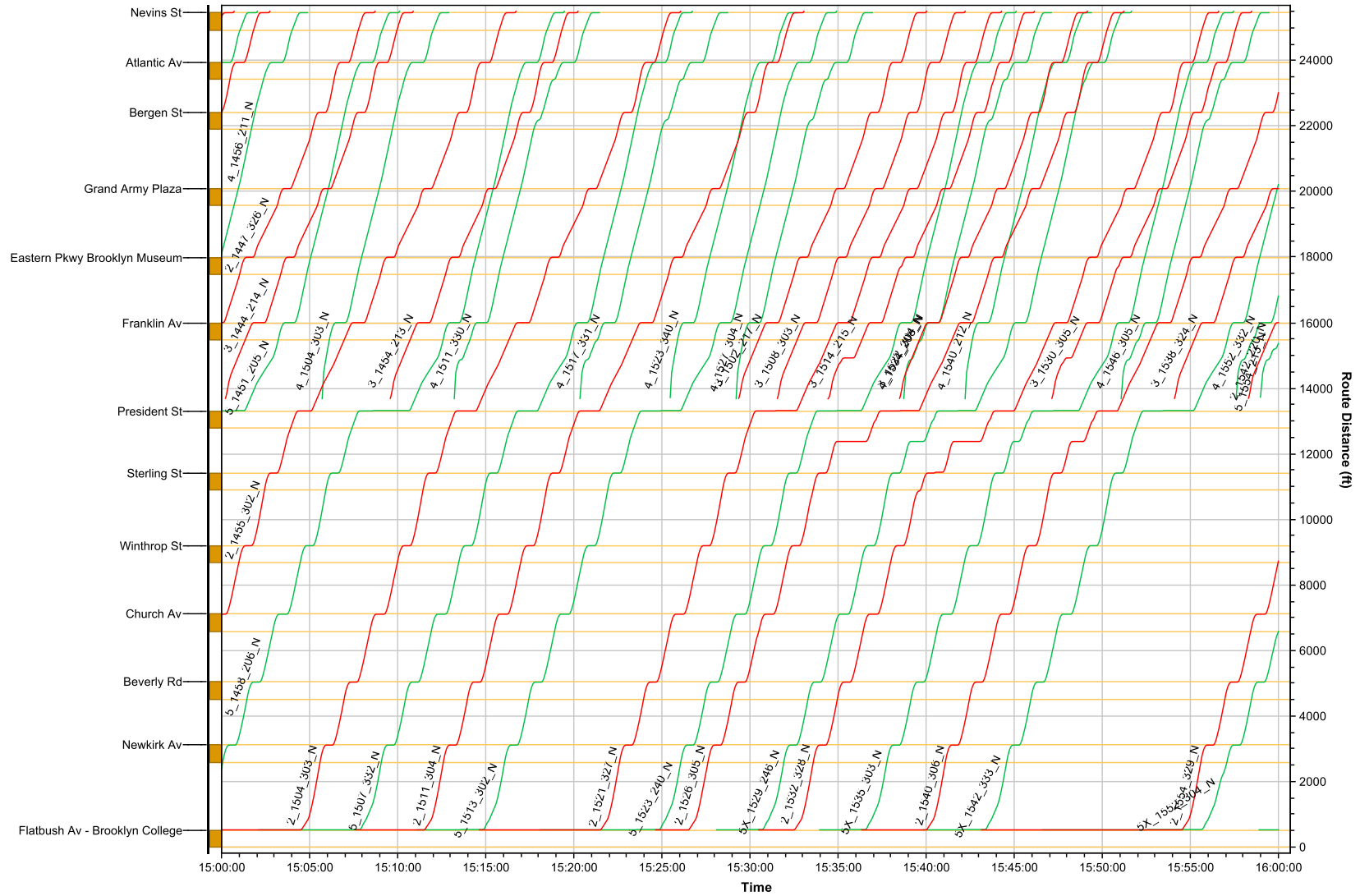
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Figure F.3-52: String Chart - Flatbush Avenue-Brooklyn College to Nevins Street - Northbound - 9:00 to 10:00 a.m.



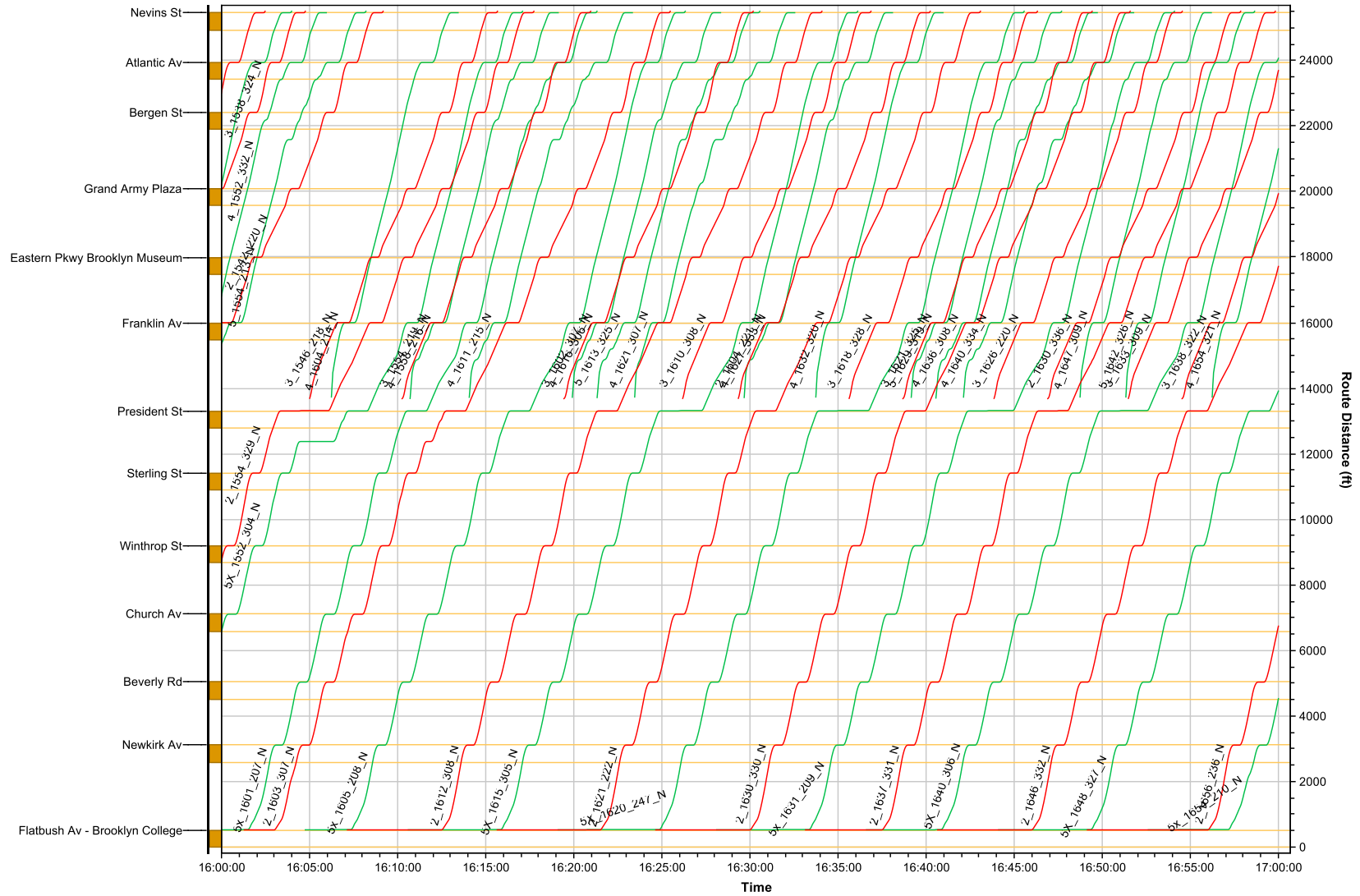
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Figure F.3-53: String Chart - Flatbush Avenue-Brooklyn College to Nevins Street - Northbound - 3:00 to 4:00 p.m.



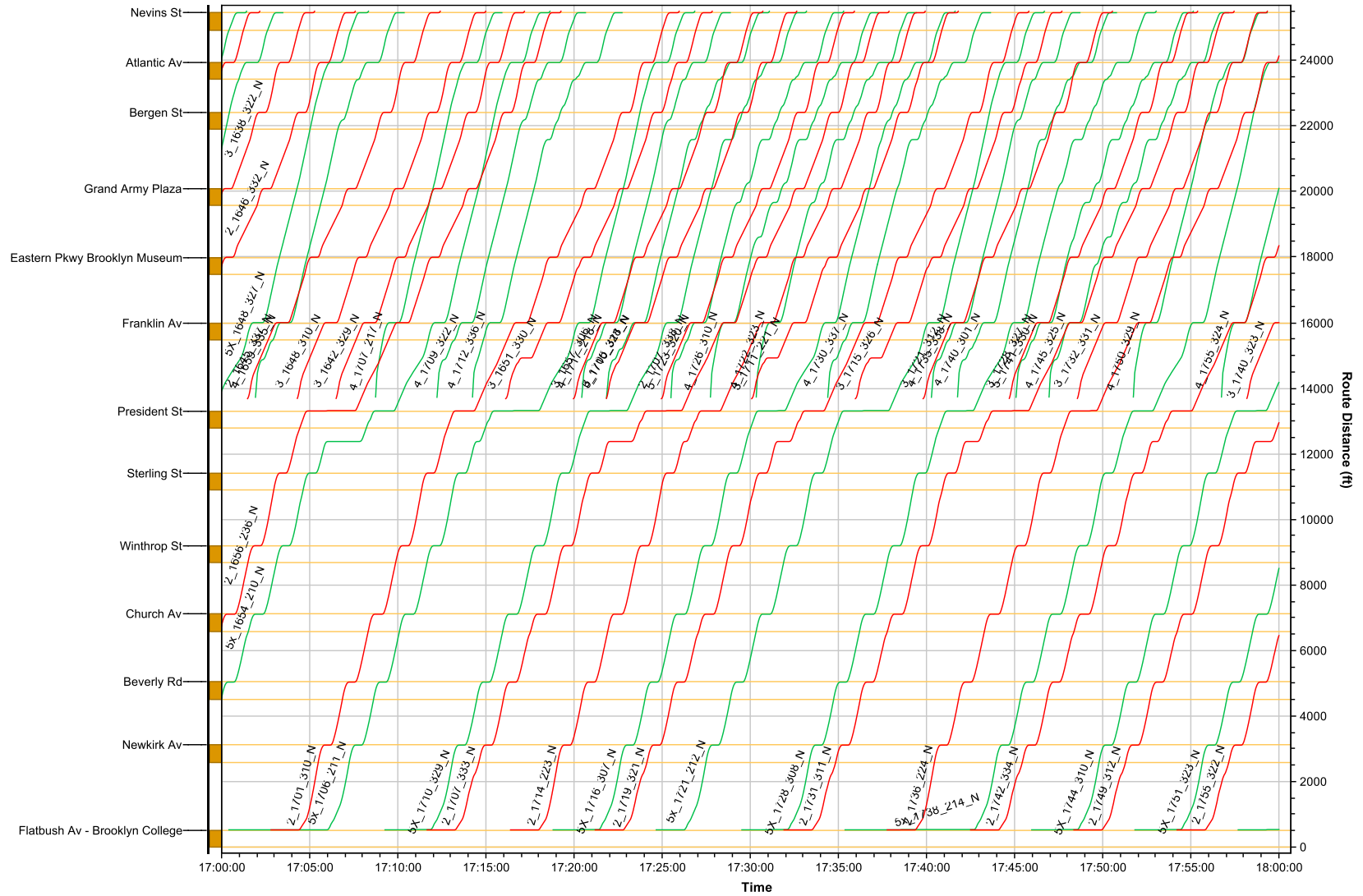
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Figure F.3-54: String Chart - Flatbush Avenue-Brooklyn College to Nevins Street - Northbound - 4:00 to 5:00 p.m.



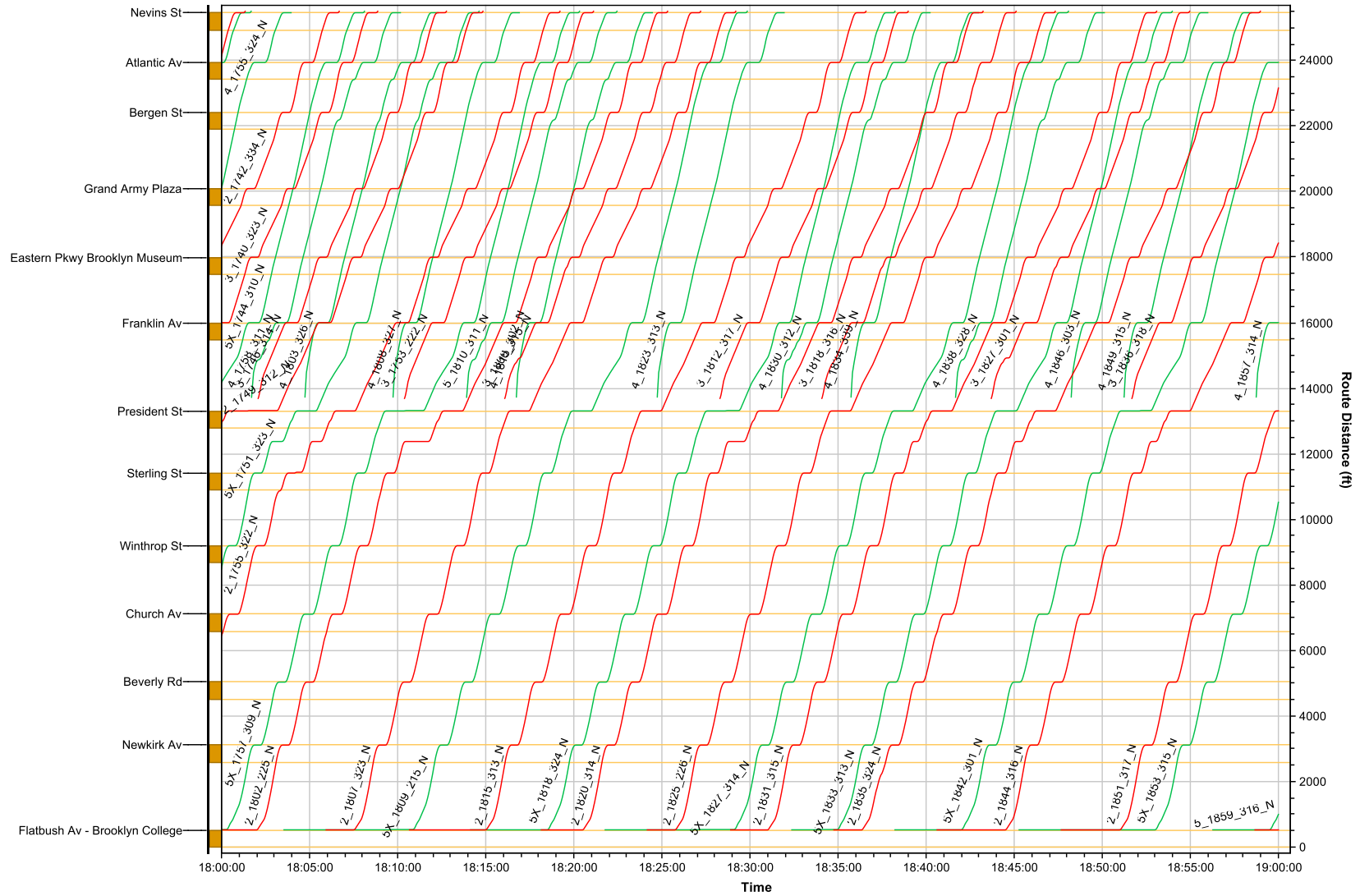
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Figure F.3-55: String Chart - Flatbush Avenue-Brooklyn College to Nevins Street - Northbound - 5:00 to 6:00 p.m.



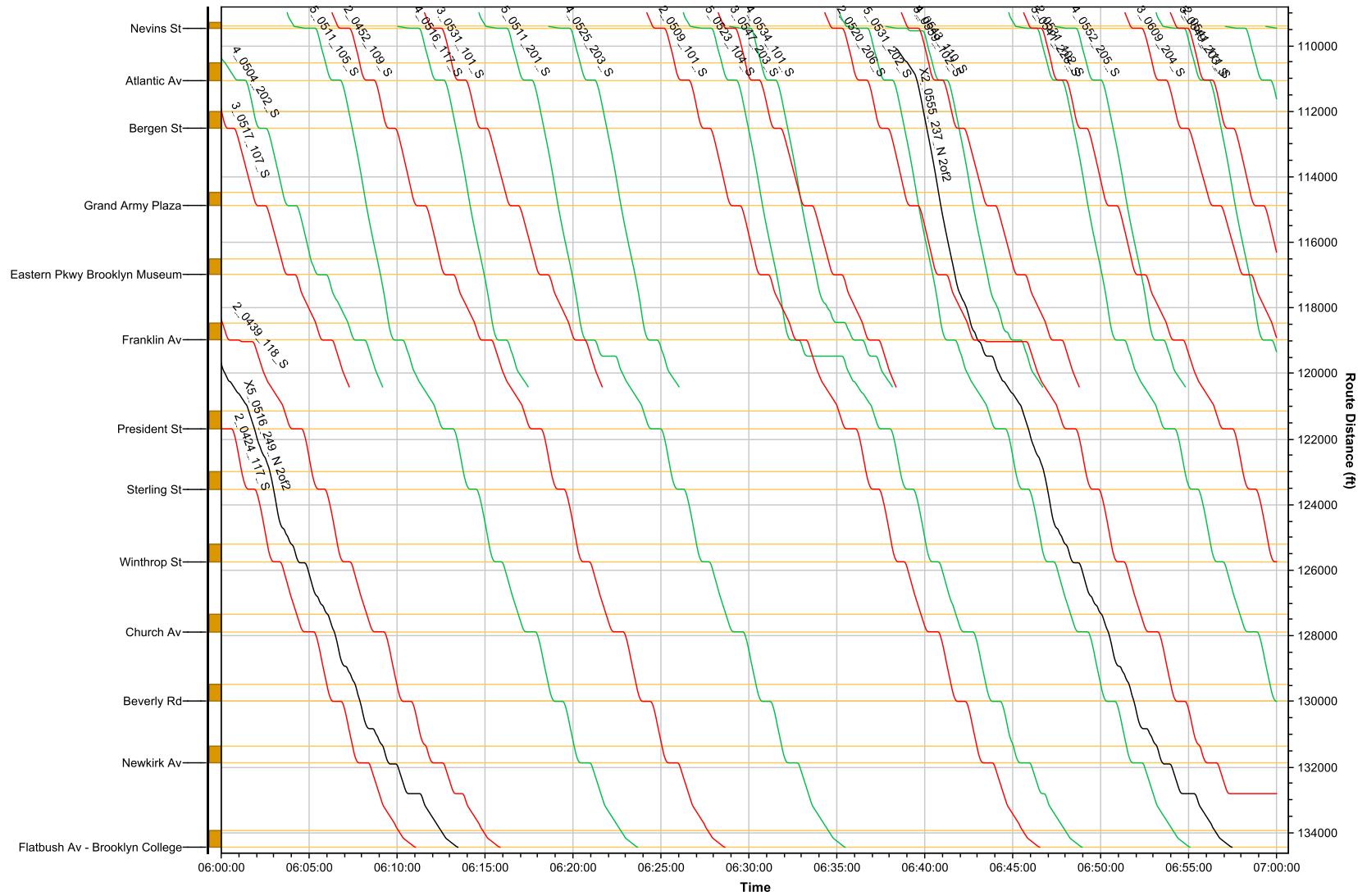
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Figure F.3-56: String Chart - Flatbush Avenue-Brooklyn College to Nevins Street - Northbound - 6:00 to 7:00 p.m.



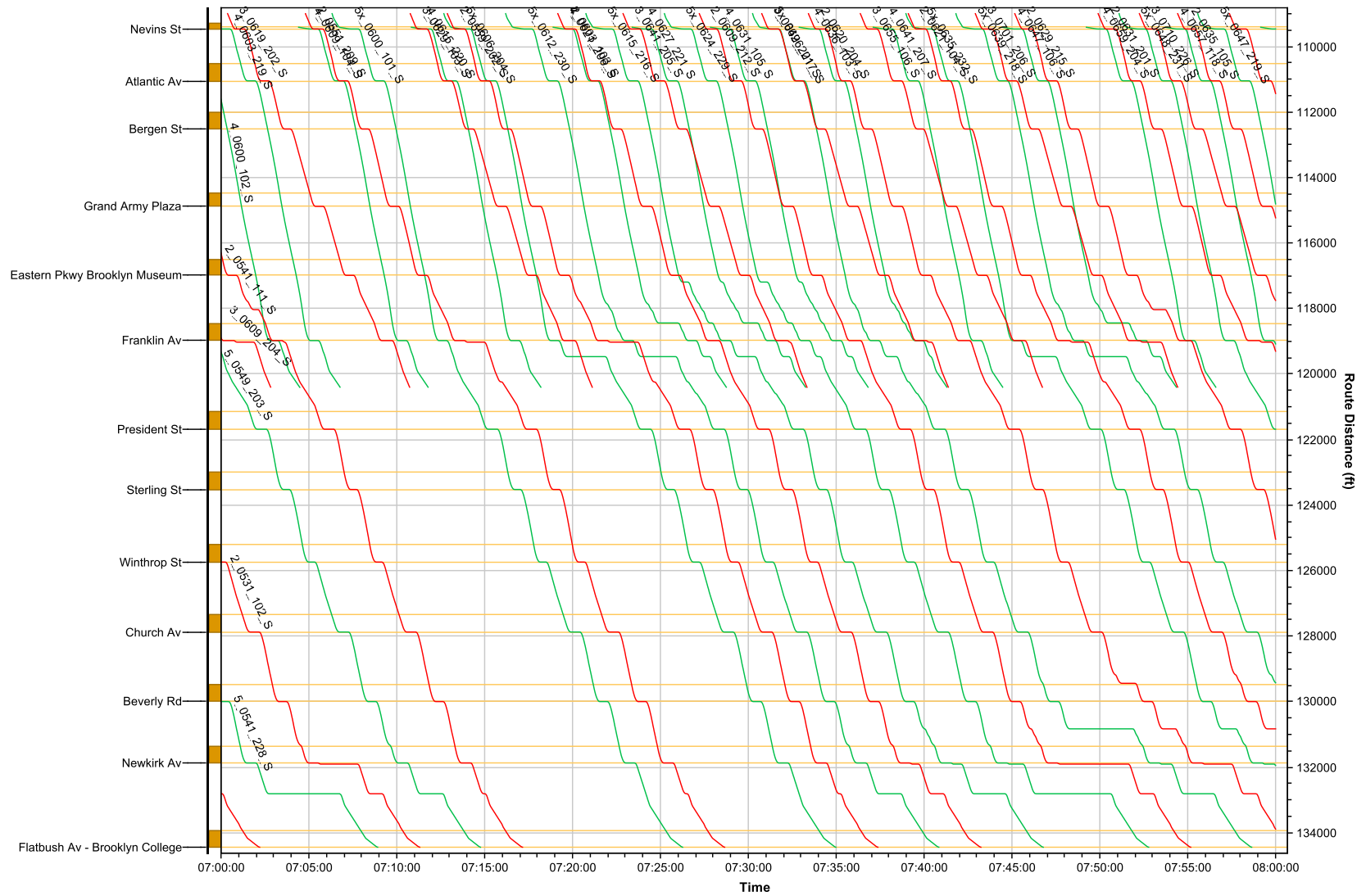
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Figure F.3-57: String Chart - Nevins Street to Flatbush Avenue-Brooklyn College - Southbound - 6:00 to 7:00 a.m.



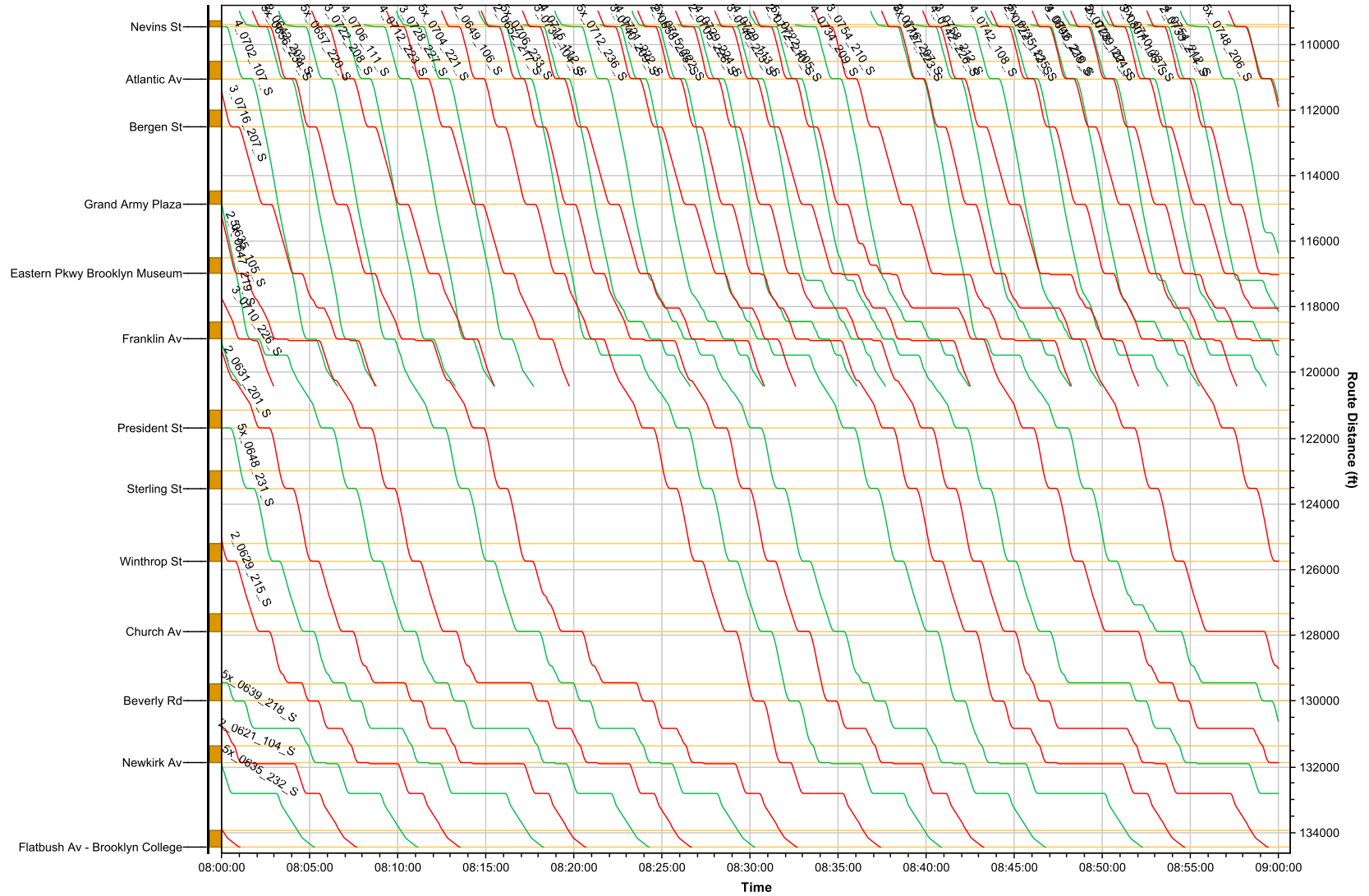
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Figure F.3-58: String Chart - Nevins Street to Flatbush Avenue-Brooklyn College - Southbound - 7:00 to 8:00 a.m.



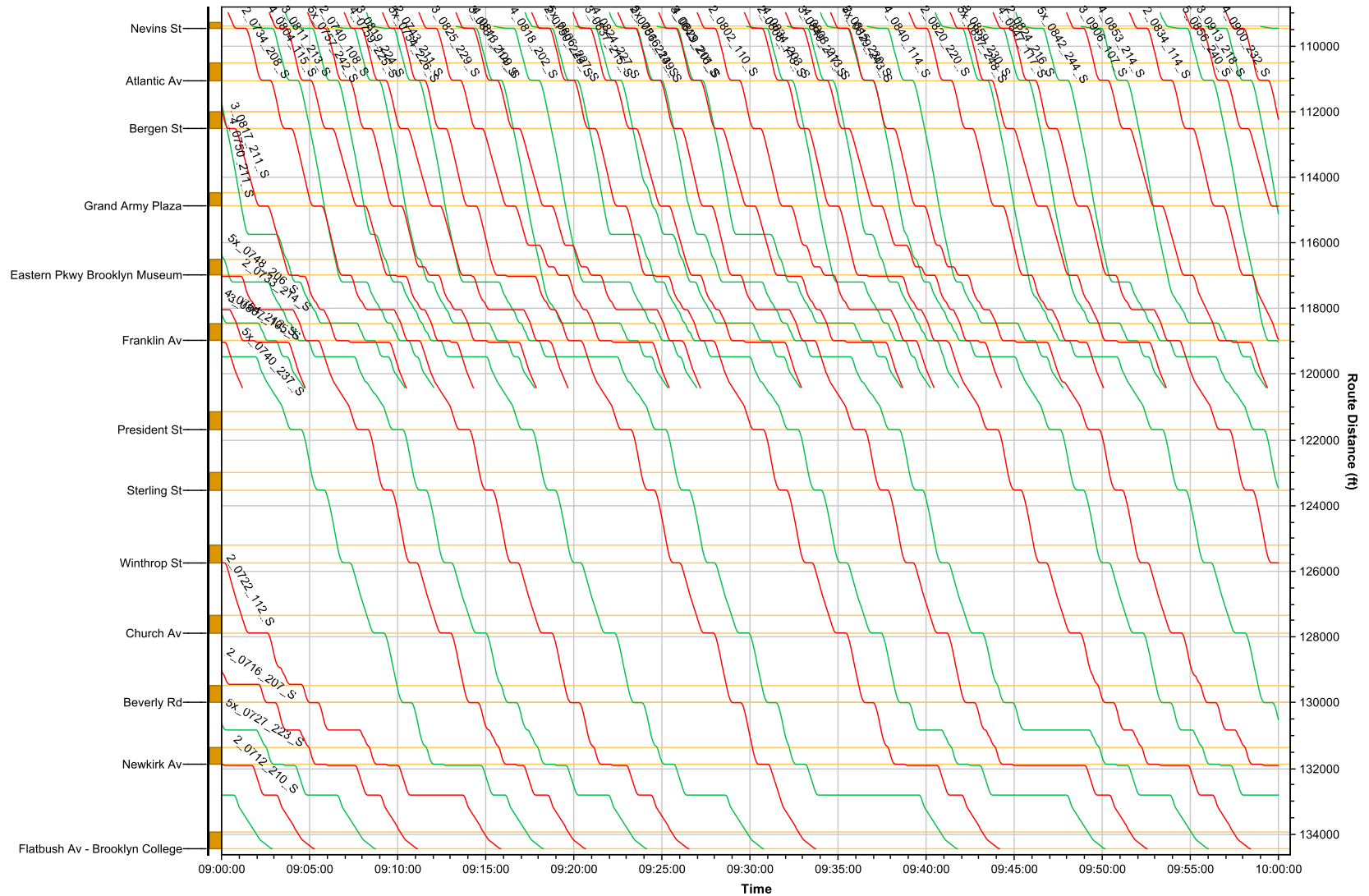
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Figure F.3-59: String Chart - Nevins Street to Flatbush Avenue-Brooklyn College - Southbound - 8:00 to 9:00 a.m.



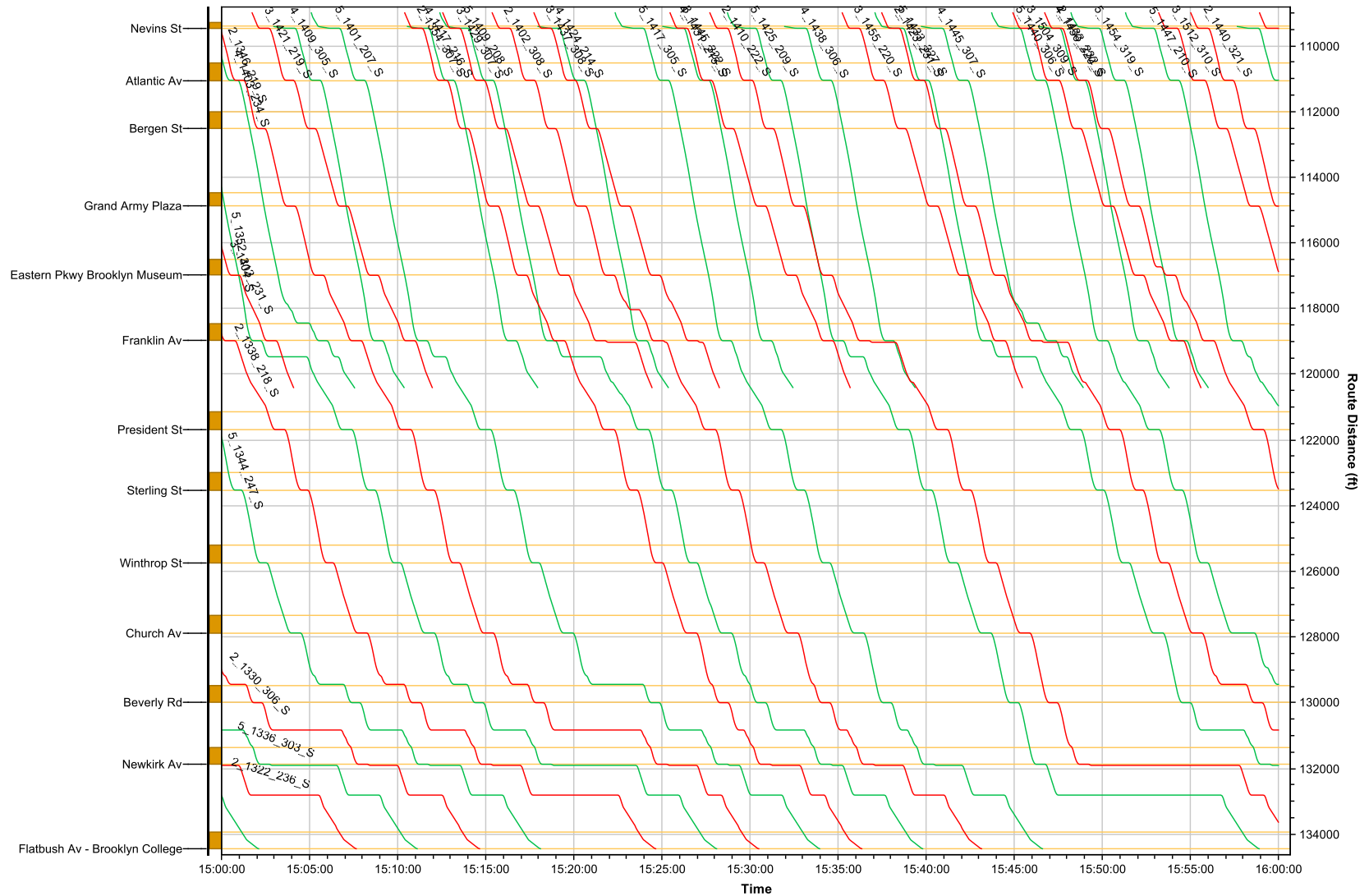
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Figure F.3-60: String Chart - Nevins Street to Flatbush Avenue-Brooklyn College - Southbound - 9:00 to 10:00 a.m.



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Figure F.3-61: String Chart - Nevins Street to Flatbush Avenue-Brooklyn College - Southbound - 3:00 to 4:00 p.m.



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Figure F.3-62: String Chart - Nevins Street to Flatbush Avenue-Brooklyn College - Southbound - 4:00 to 5:00 p.m.

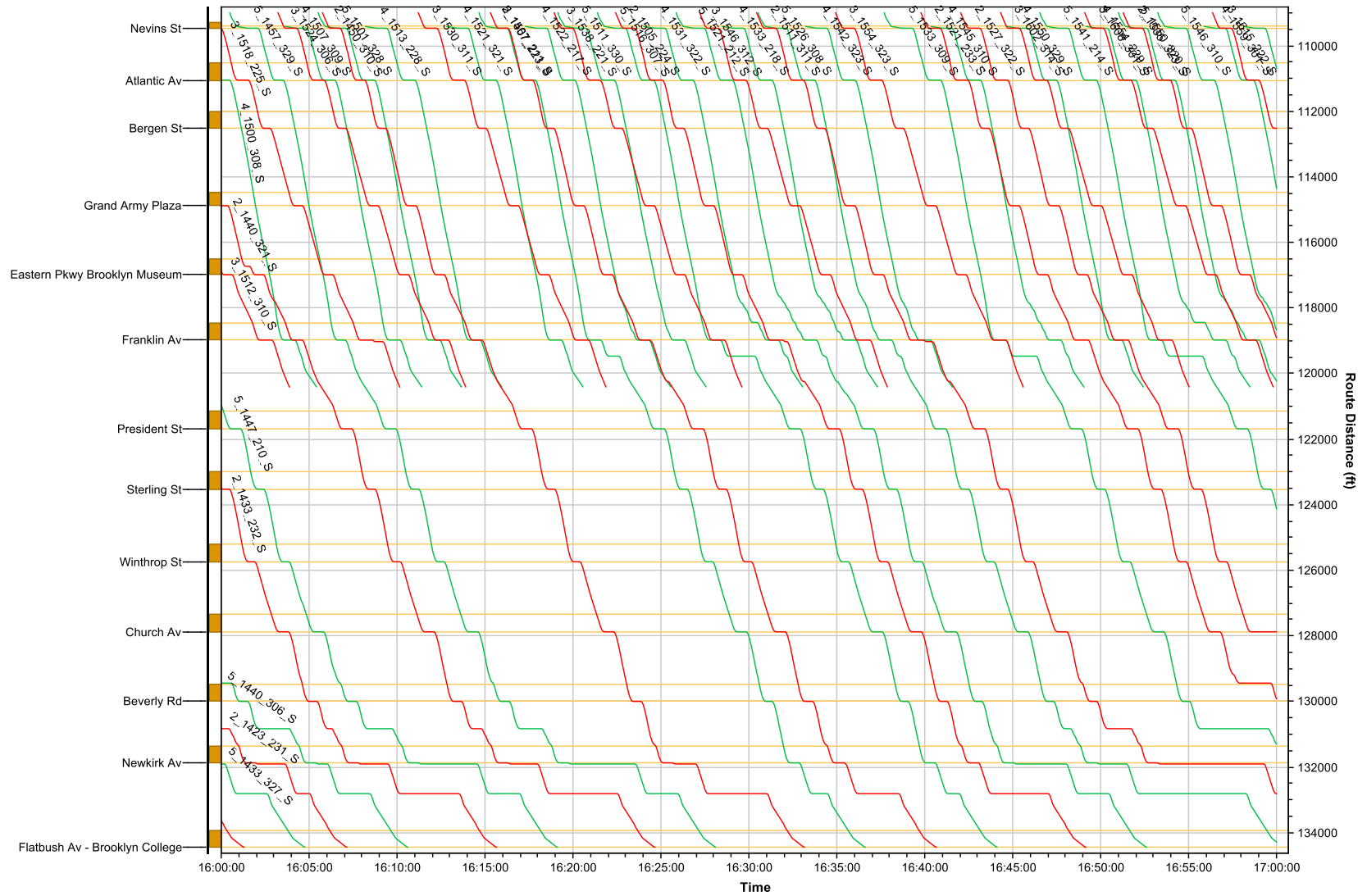
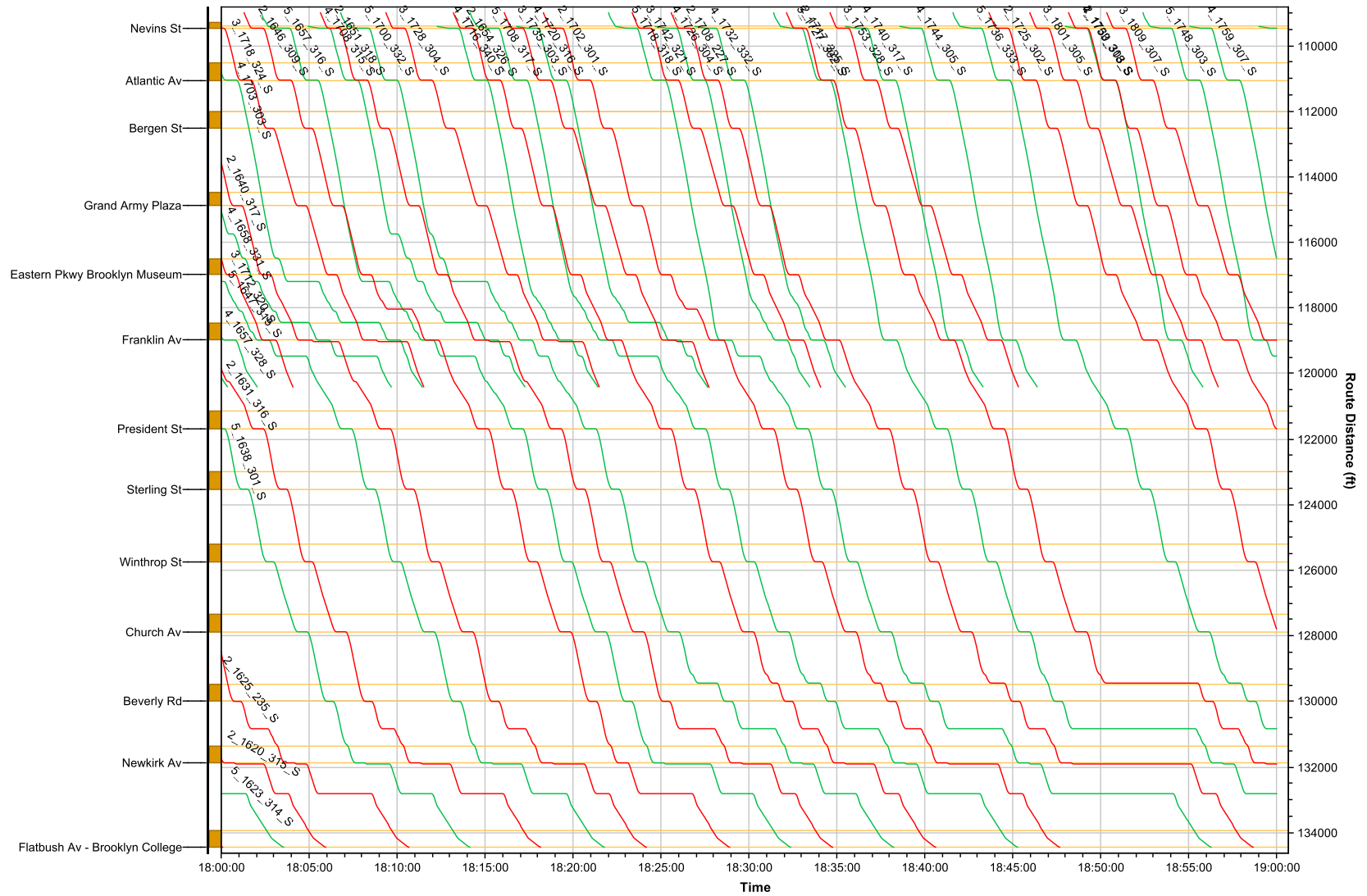


Figure F.3-63: String Chart - Nevins Street to Flatbush Avenue-Brooklyn College - Southbound - 5:00 to 6:00 p.m.



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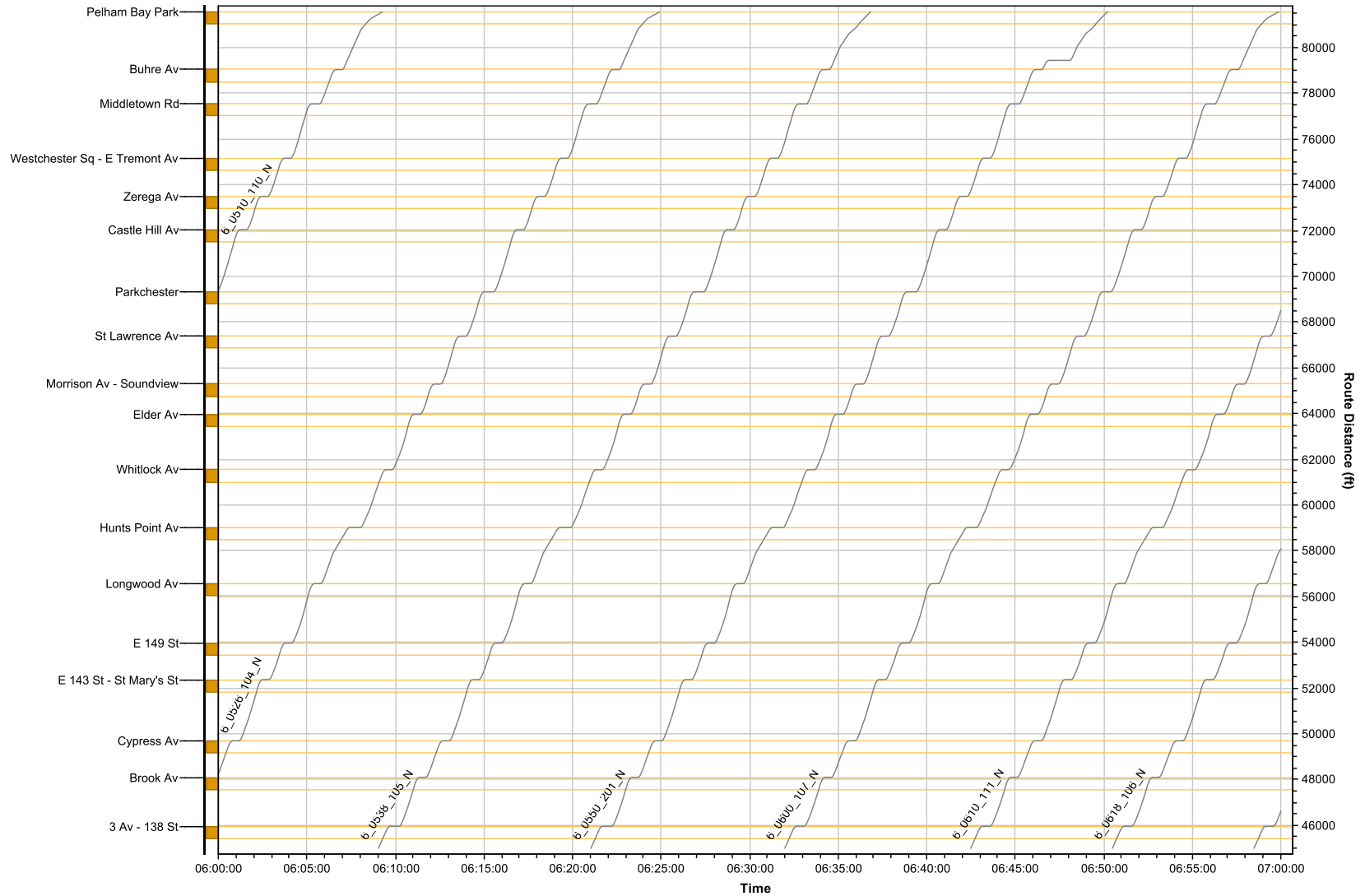
Figure F.3-64: Nevins Street to Flatbush Avenue-Brooklyn College - Southbound - 6:00 to 7:00 p.m.



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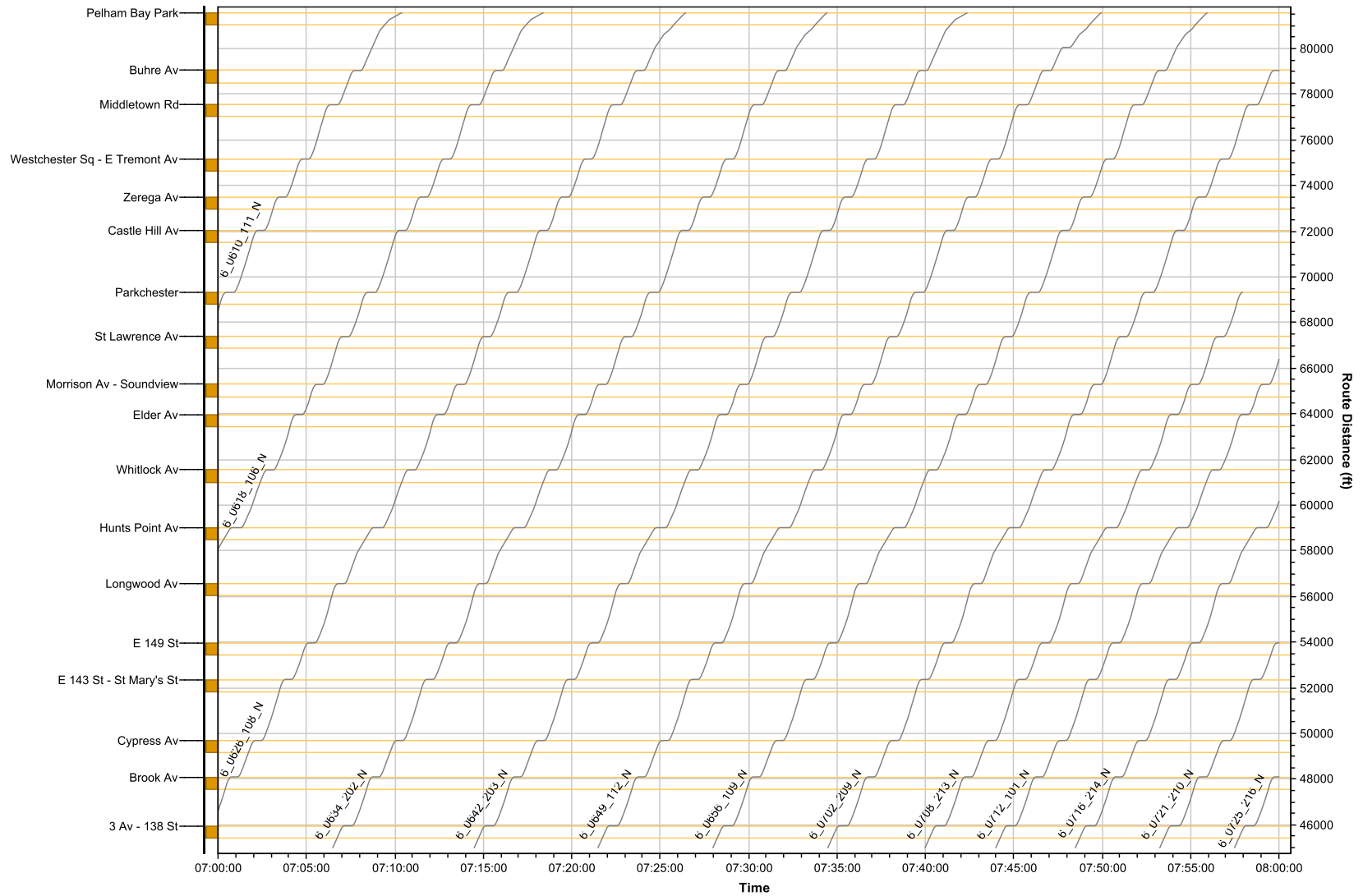
F.3.5 Pelham Bay Park to 3 Avenue-138 Street

Figure F.3-65: String Chart – 3 Avenue-138 Street to Pelham Bay Park – Northbound – 6:00 to 7:00 a.m.



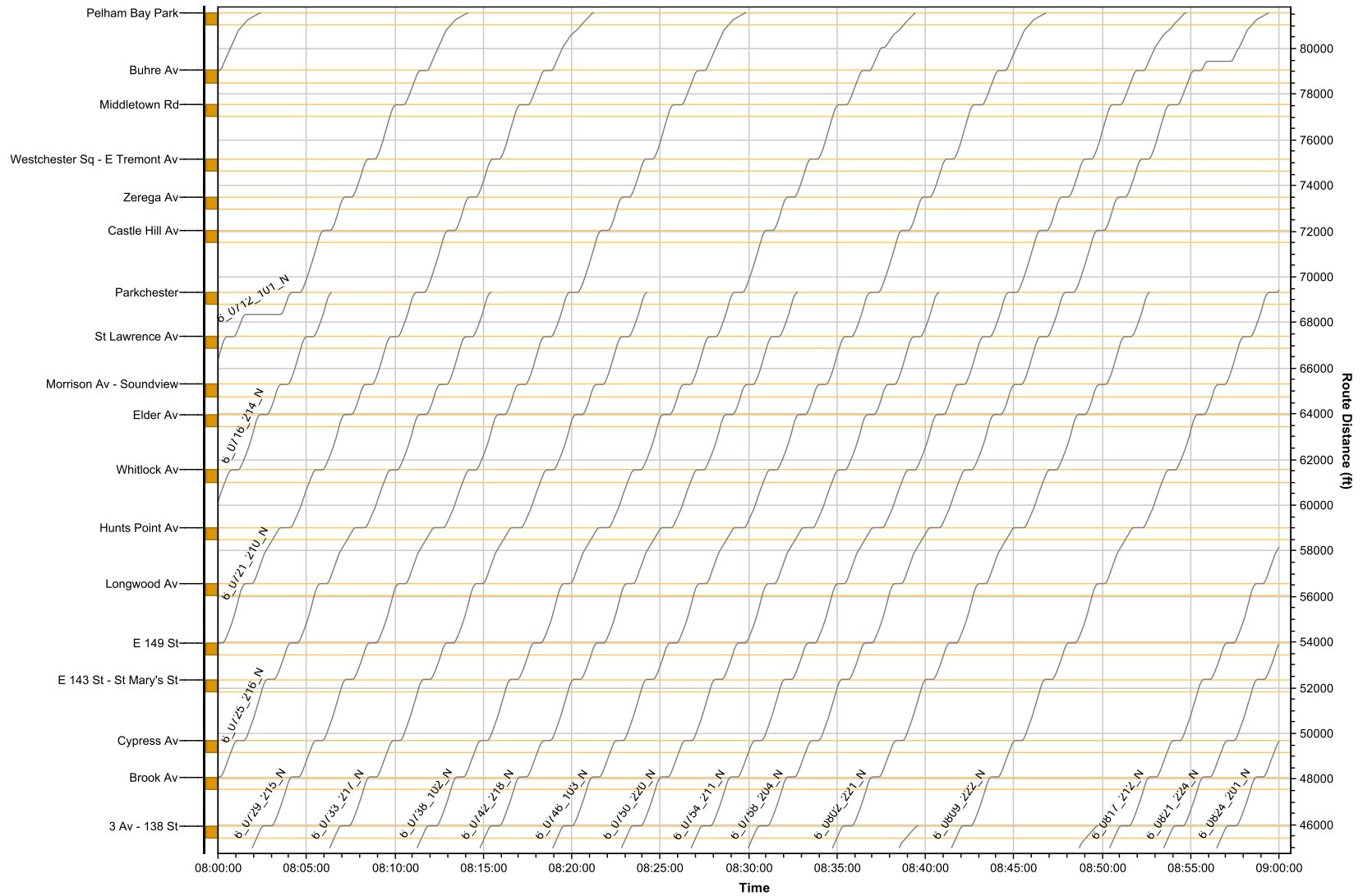
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-66: String Chart – 3 Avenue-138 Street to Pelham Bay Park – Northbound – 7:00 to 8:00 a.m.



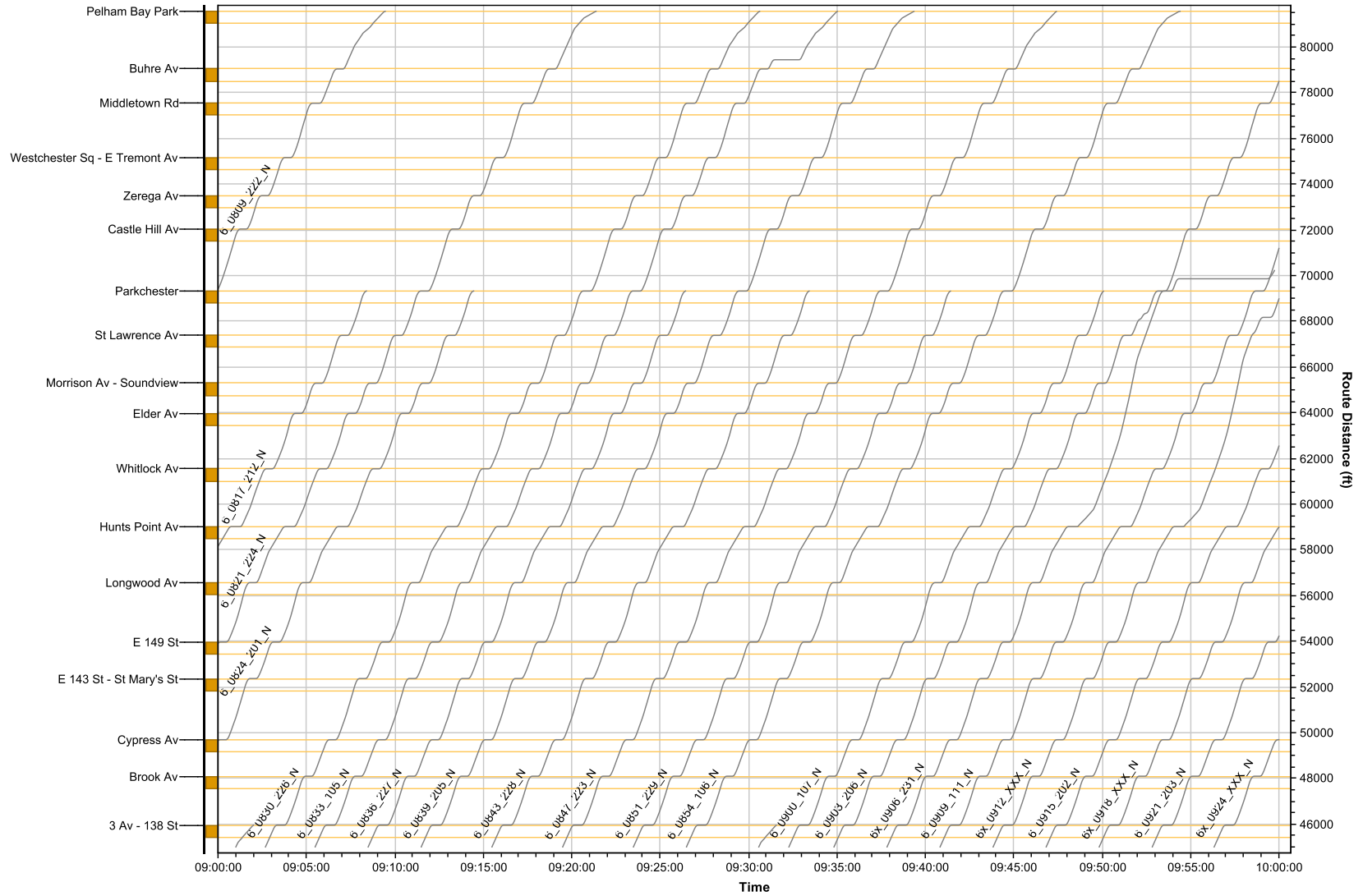
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-67: String Chart – 3 Avenue-138 Street to Pelham Bay Park – Northbound – 8:00 to 9:00 a.m.



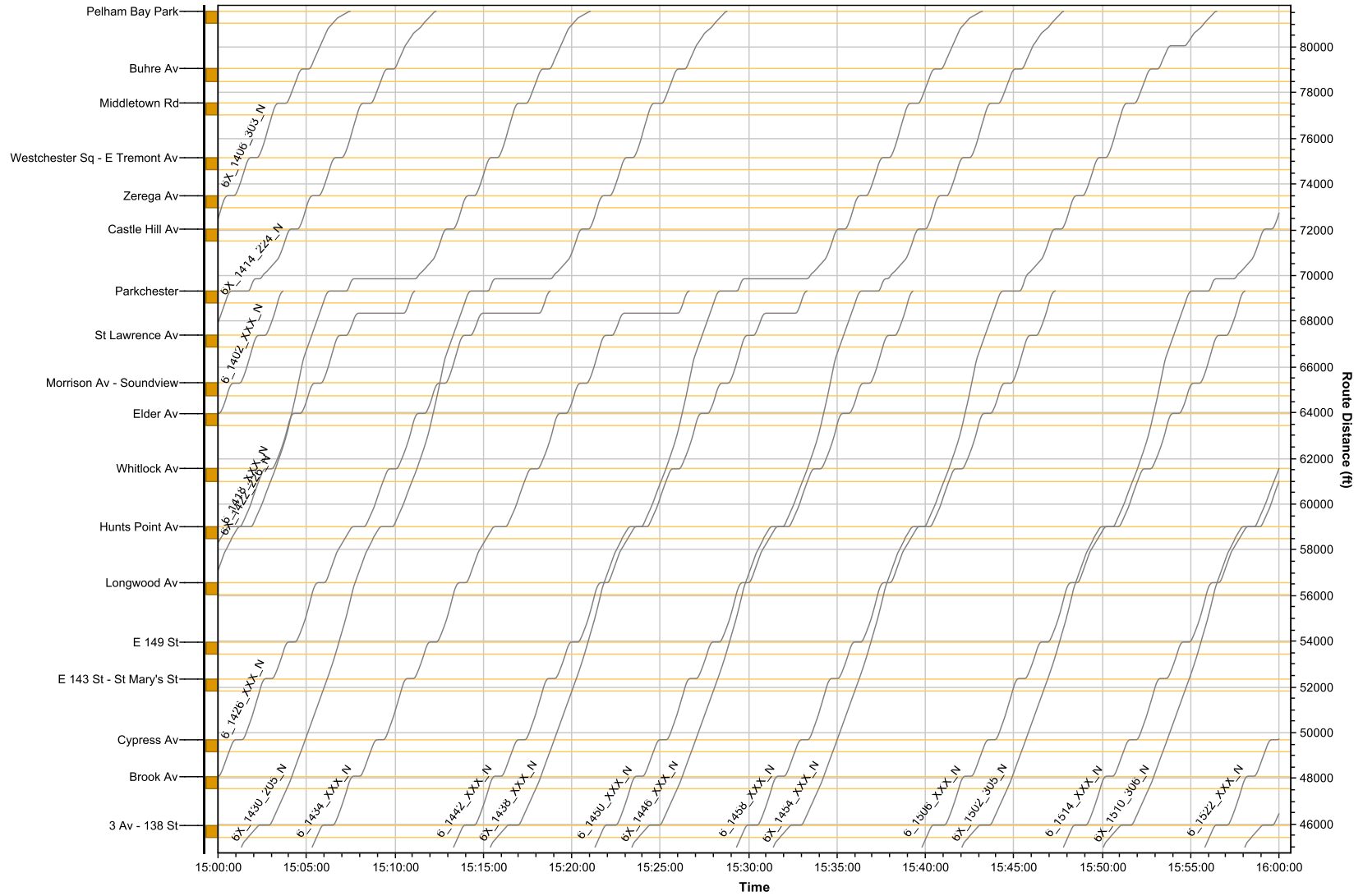
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-68: String Chart – 3 Avenue-138 Street to Pelham Bay Park – Northbound – 9:00 to 10:00 a.m.



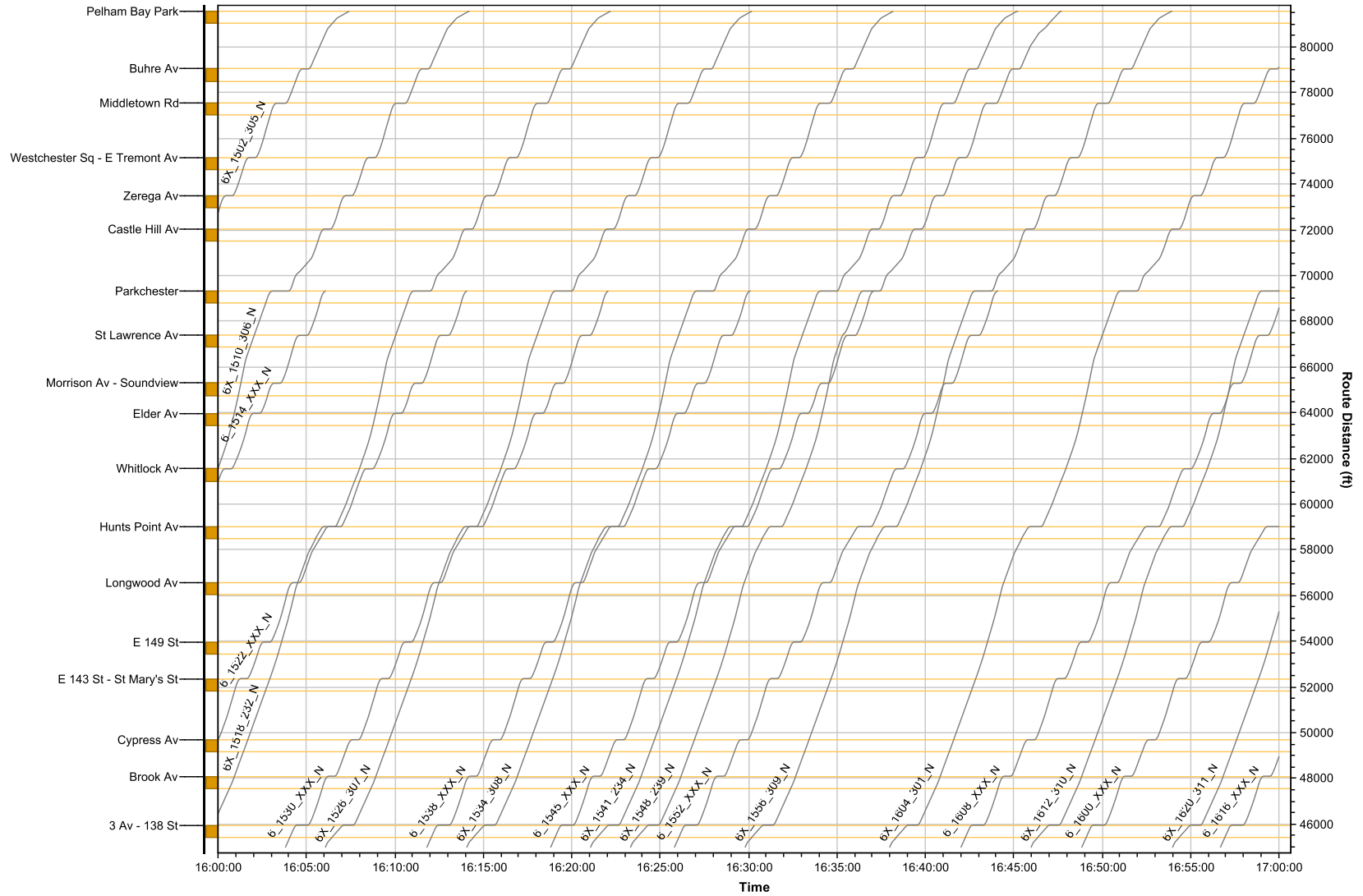
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-69: String Chart – 3 Avenue-138 Street to Pelham Bay Park – Northbound – 3:00 to 4:00 p.m.



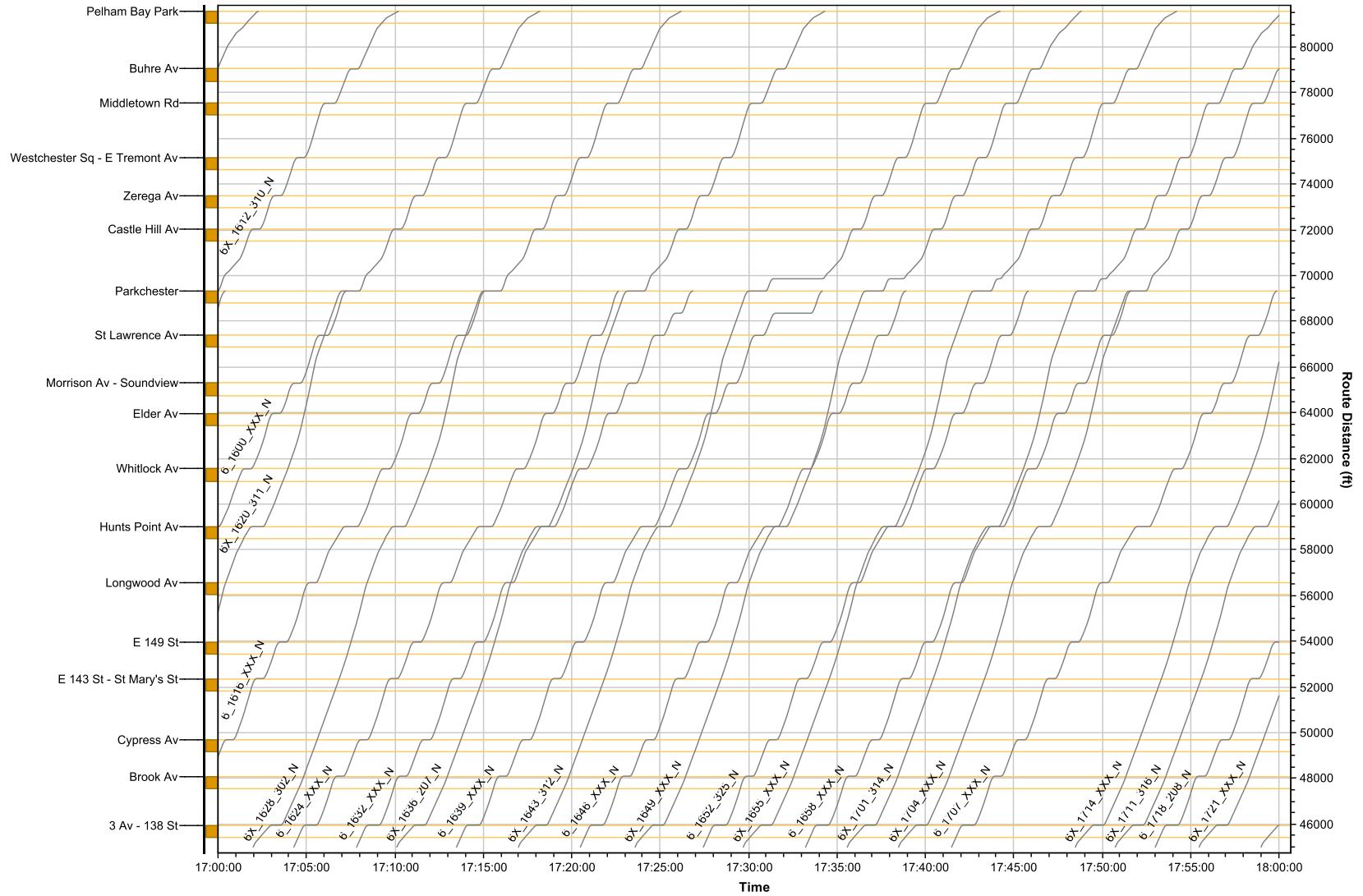
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-70: String Chart – 3 Avenue-138 Street to Pelham Bay Park – Northbound – 4:00 to 5:00 p.m.



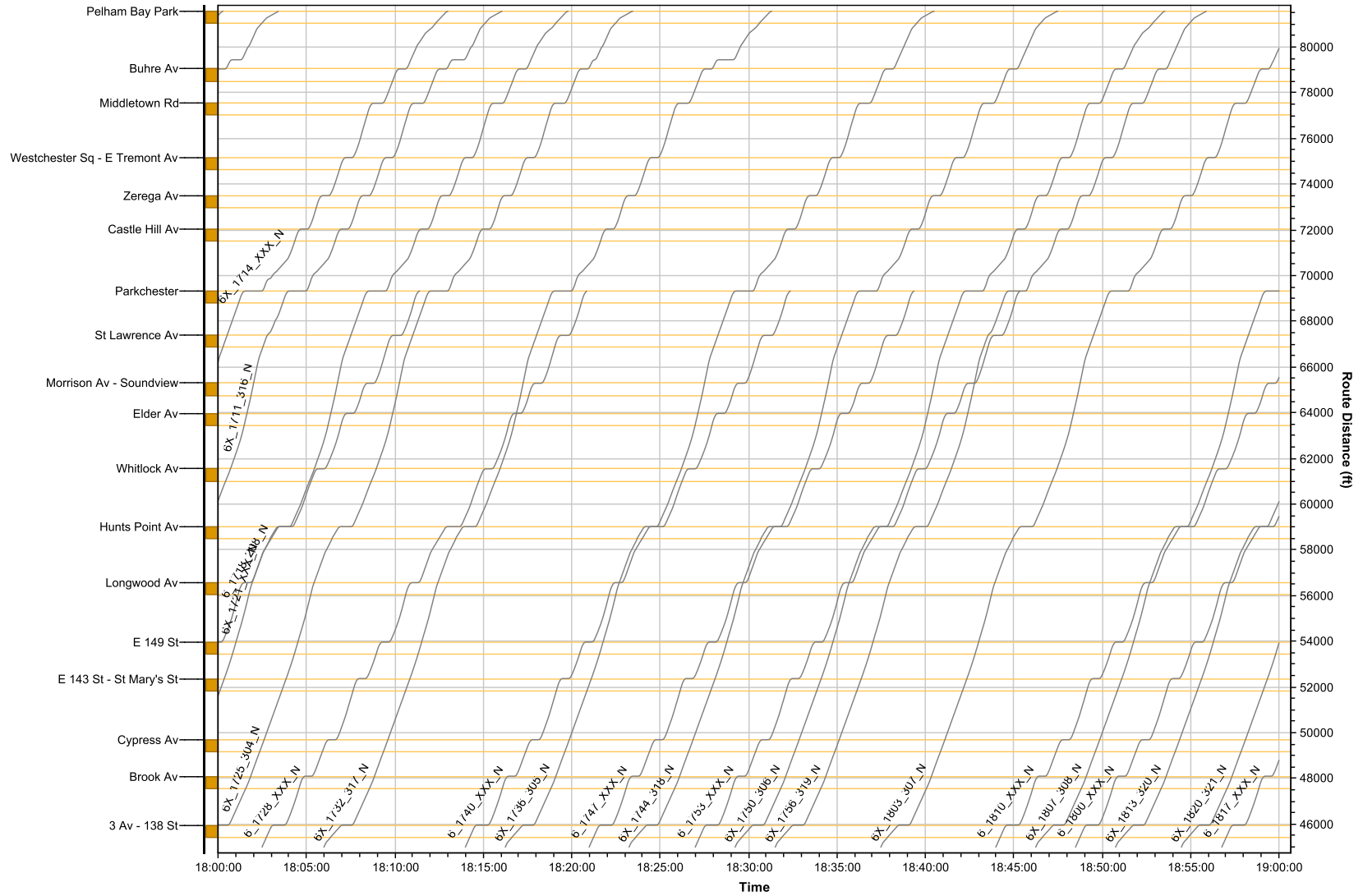
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-71: String Chart – 3 Avenue-138 Street to Pelham Bay Park – Northbound – 5:00 to 6:00 p.m.



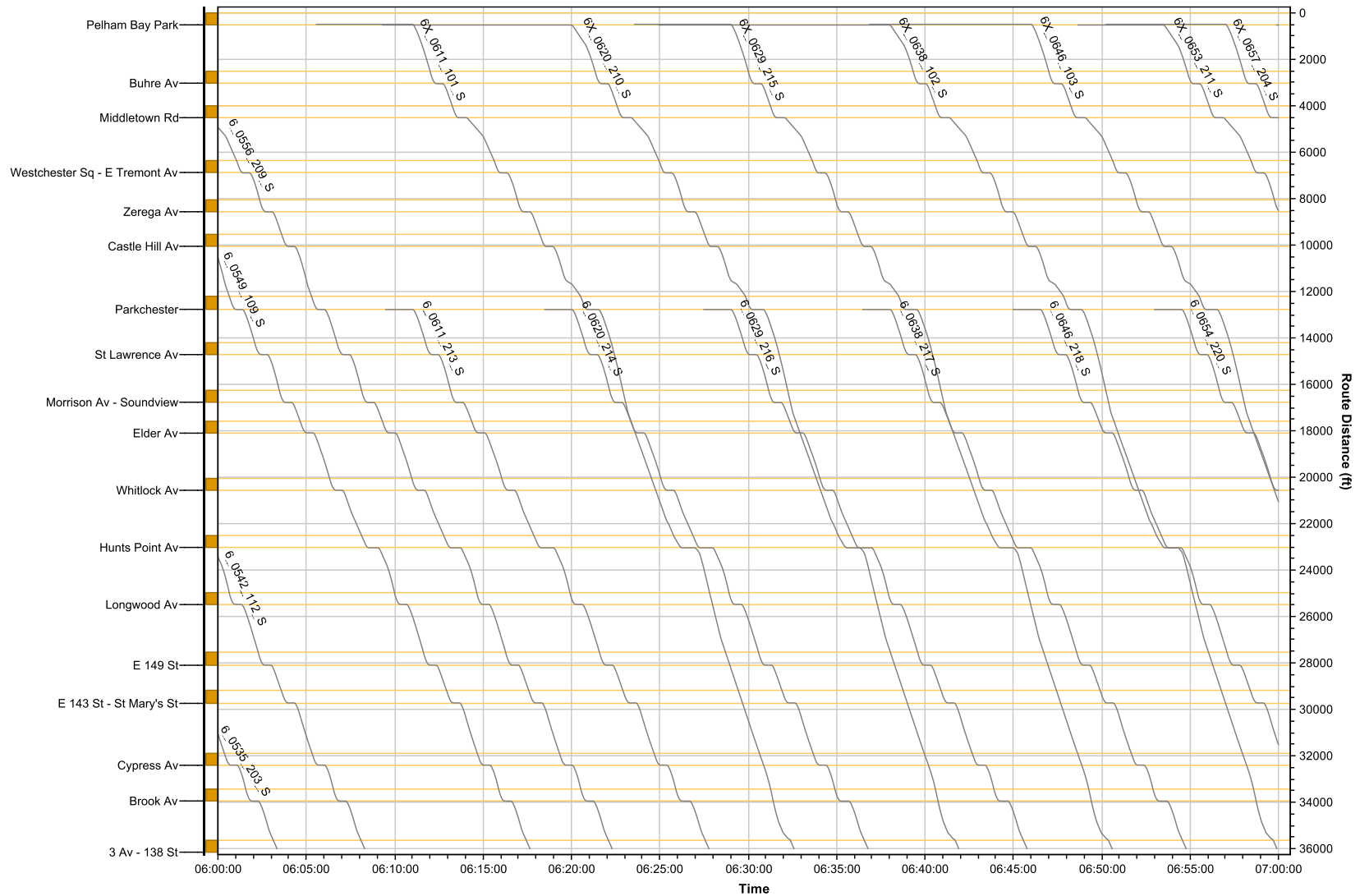
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-72: String Chart – 3 Avenue-138 Street to Pelham Bay Park – Northbound – 6:00 to 7:00 p.m.



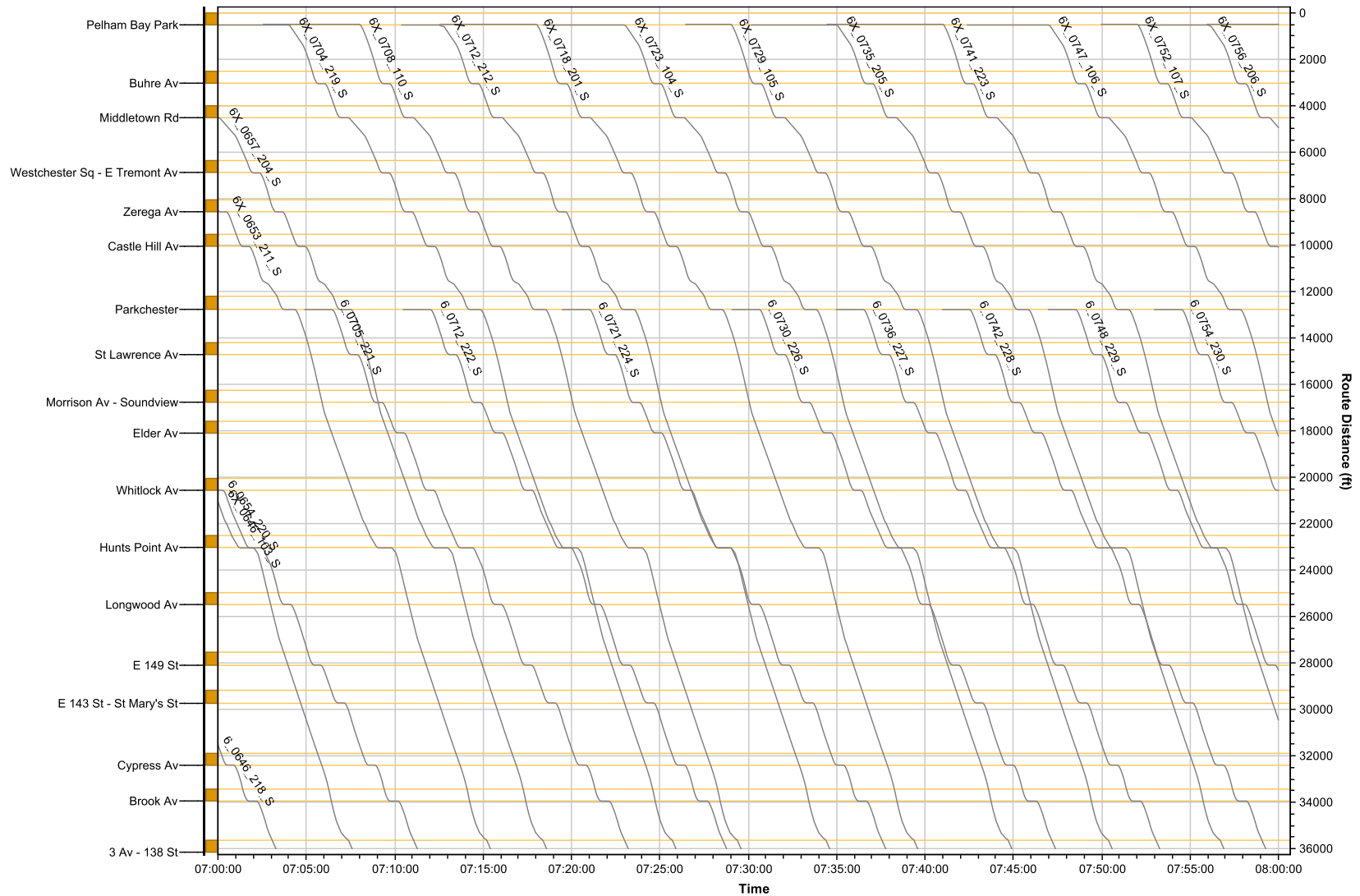
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-73: String Chart – Pelham Bay Park to 3 Avenue-138 Street – Southbound – 6:00 to 7:00 a.m.



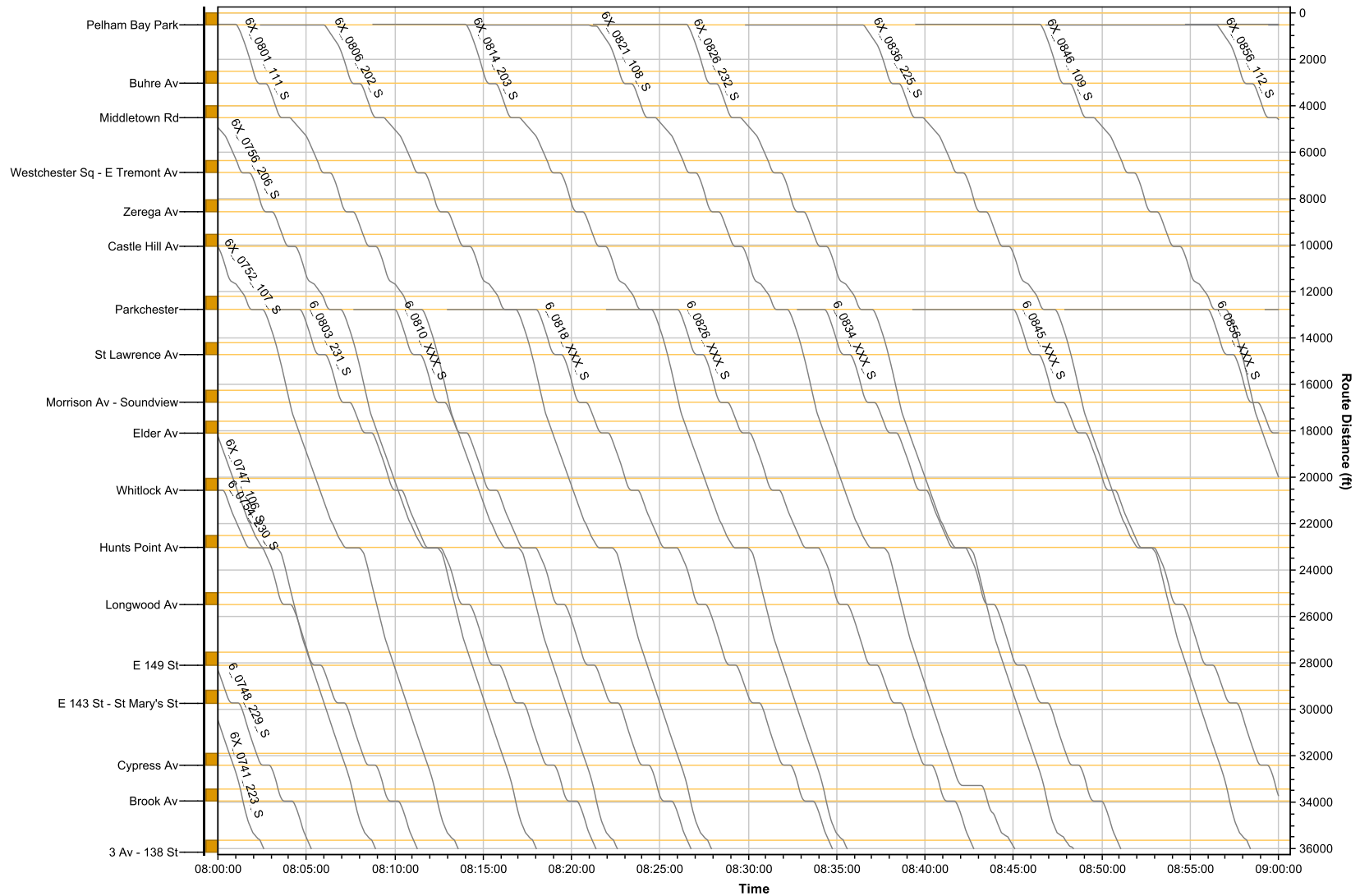
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-74: String Chart – Pelham Bay Park to 3 Avenue-138 Street – Southbound – 7:00 to 8:00 a.m.



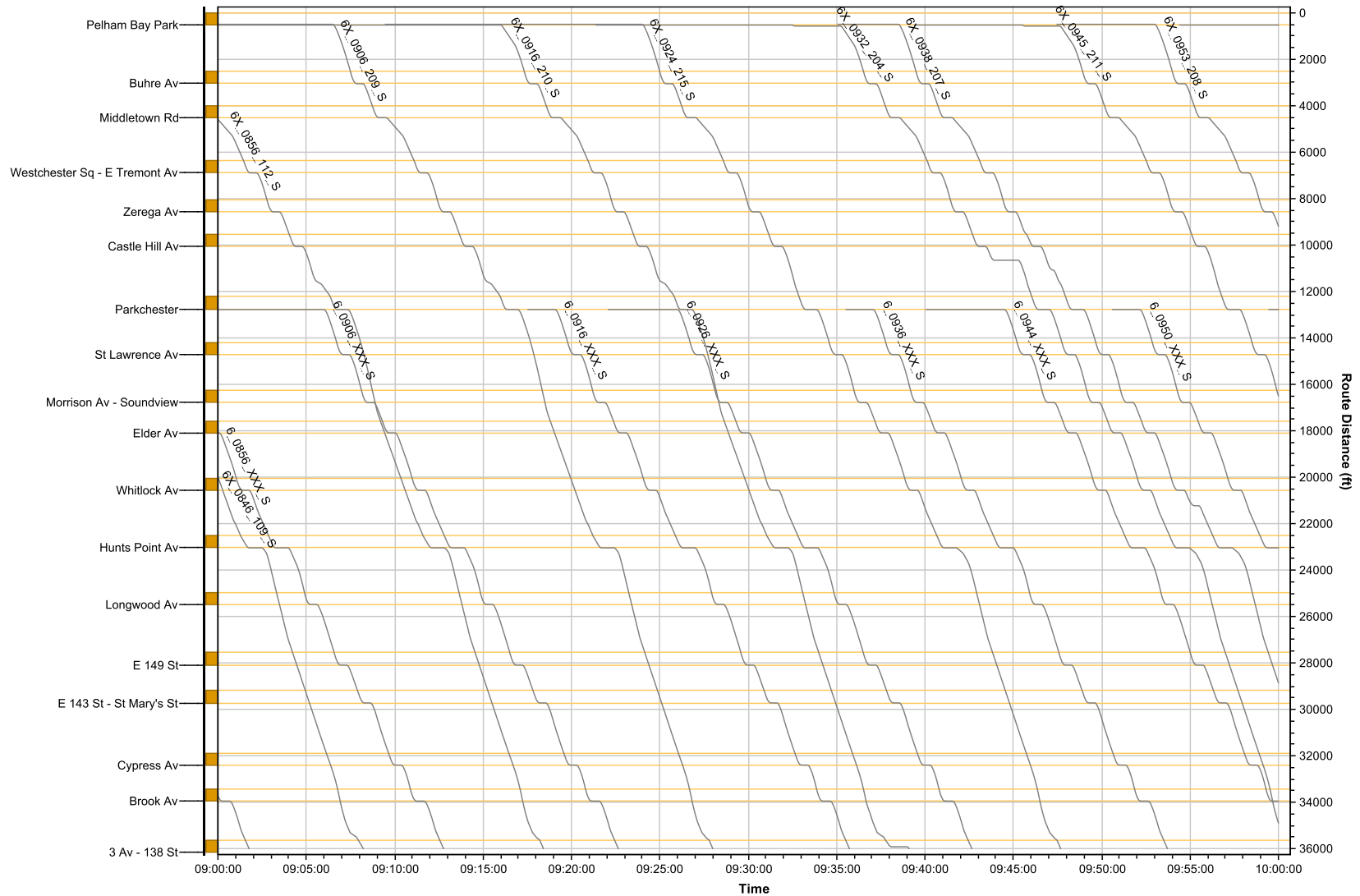
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-75: String Chart – Pelham Bay Park to 3 Avenue-138 Street – Southbound – 8:00 to 9:00 a.m.



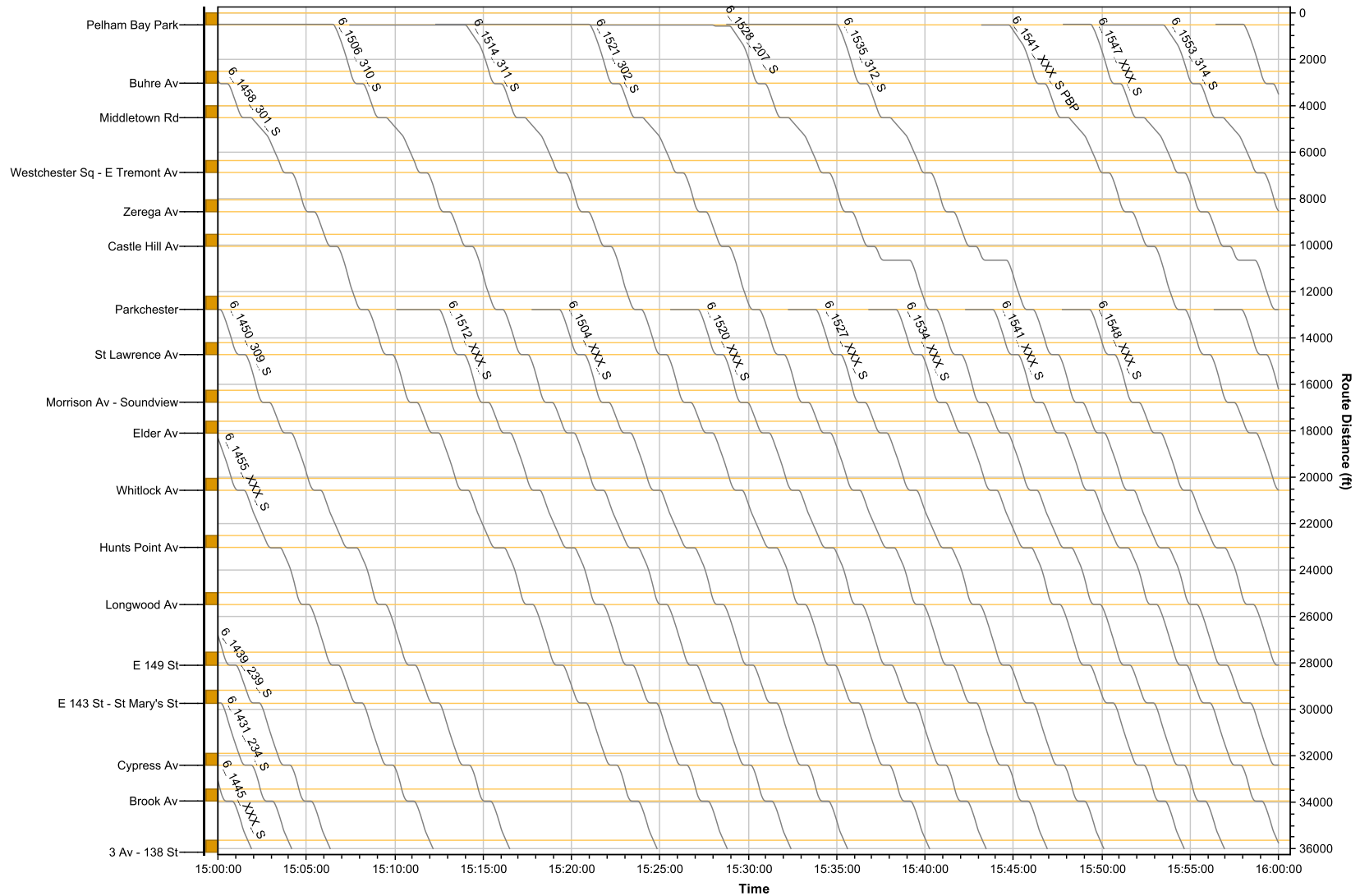
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-76: String Chart – Pelham Bay Park 3 Avenue-138 Street – Southbound – 9:00 to 10:00 a.m.



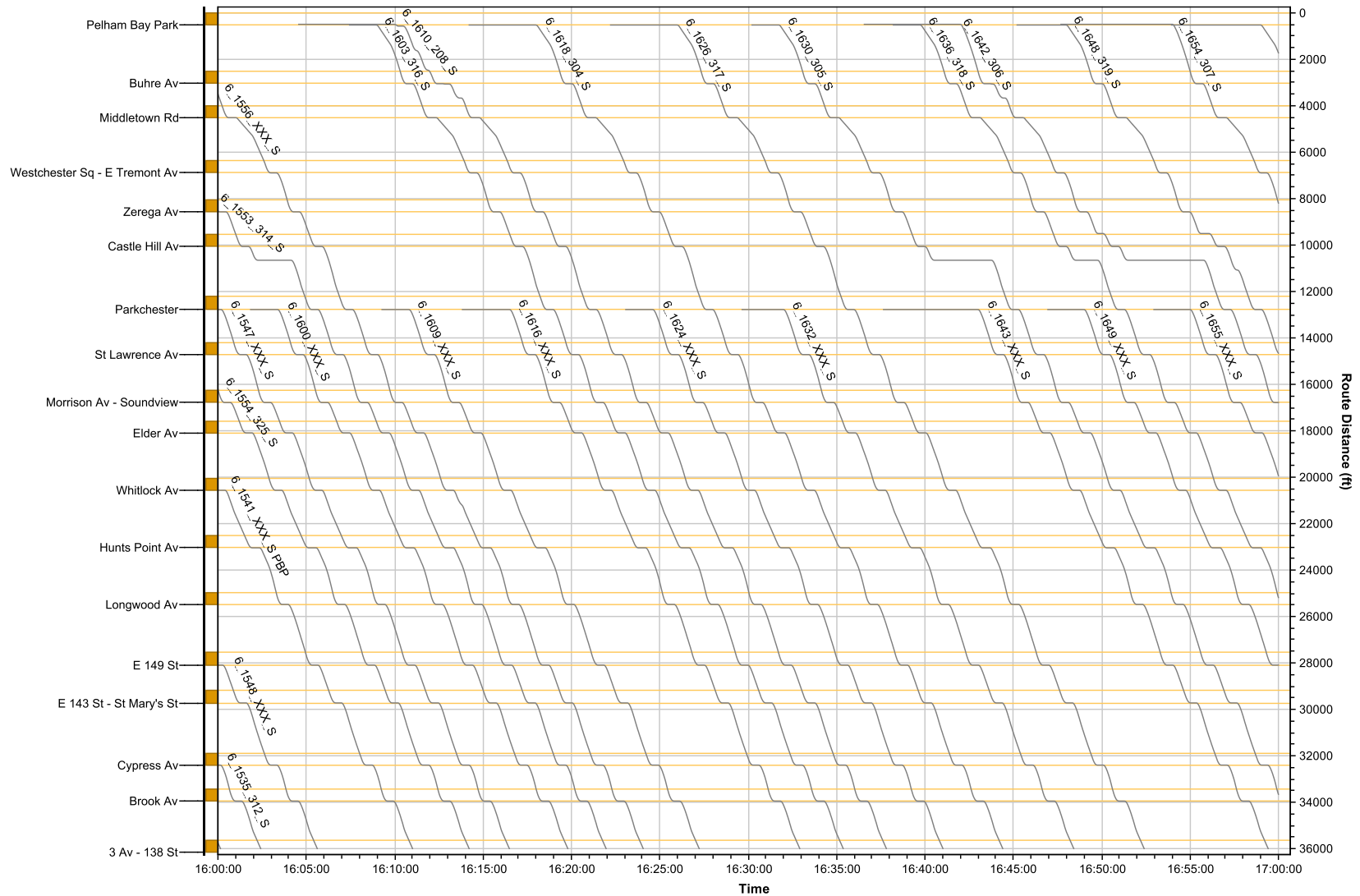
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-77: String Chart – Pelham Bay Park to 3 Avenue-138 Street – Southbound – 3:00 to 4:00 p.m.



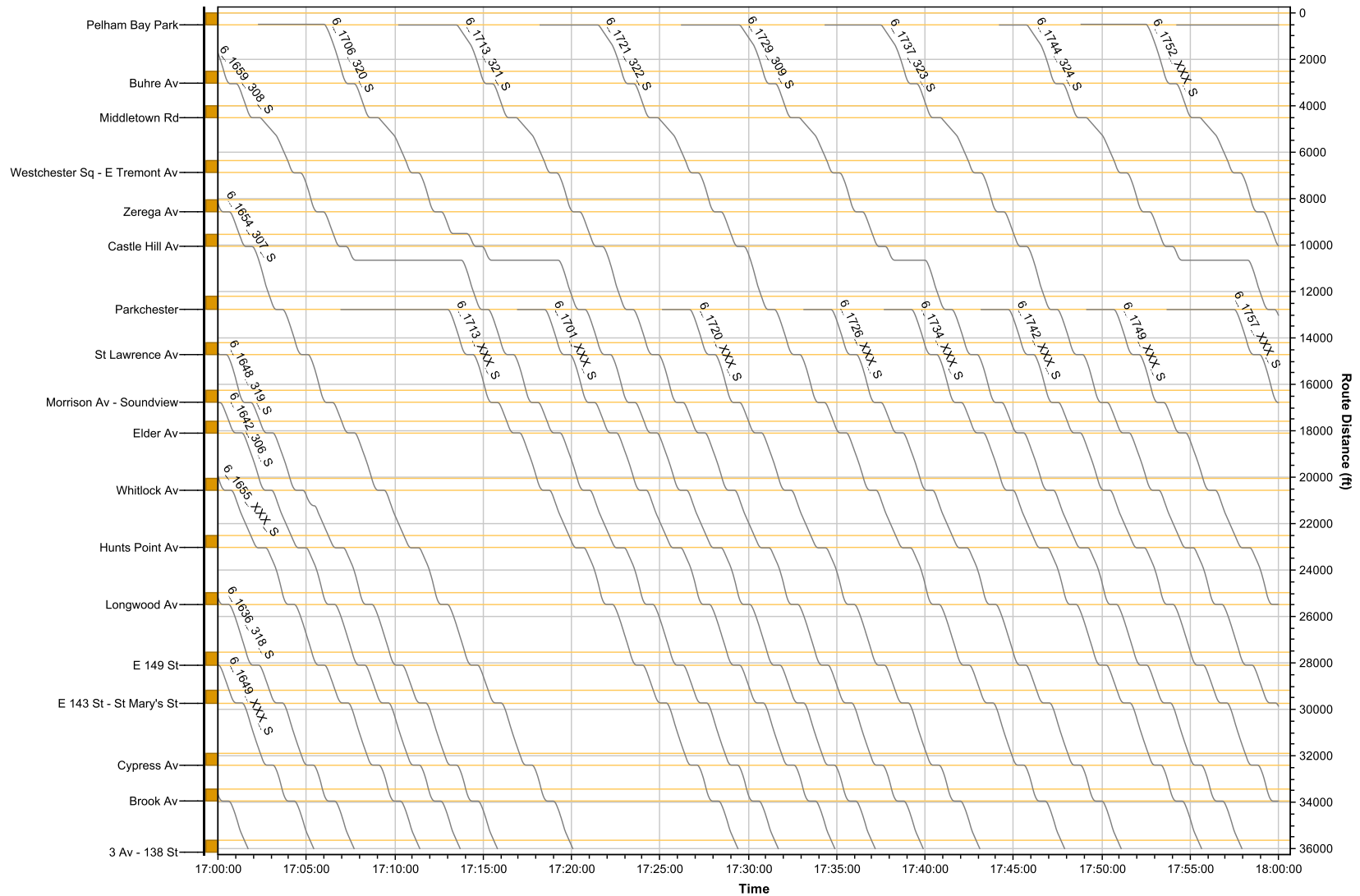
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-78: String Chart – Pelham Bay Park to 3 Avenue-138 Street – Southbound – 4:00 to 5:00 p.m.



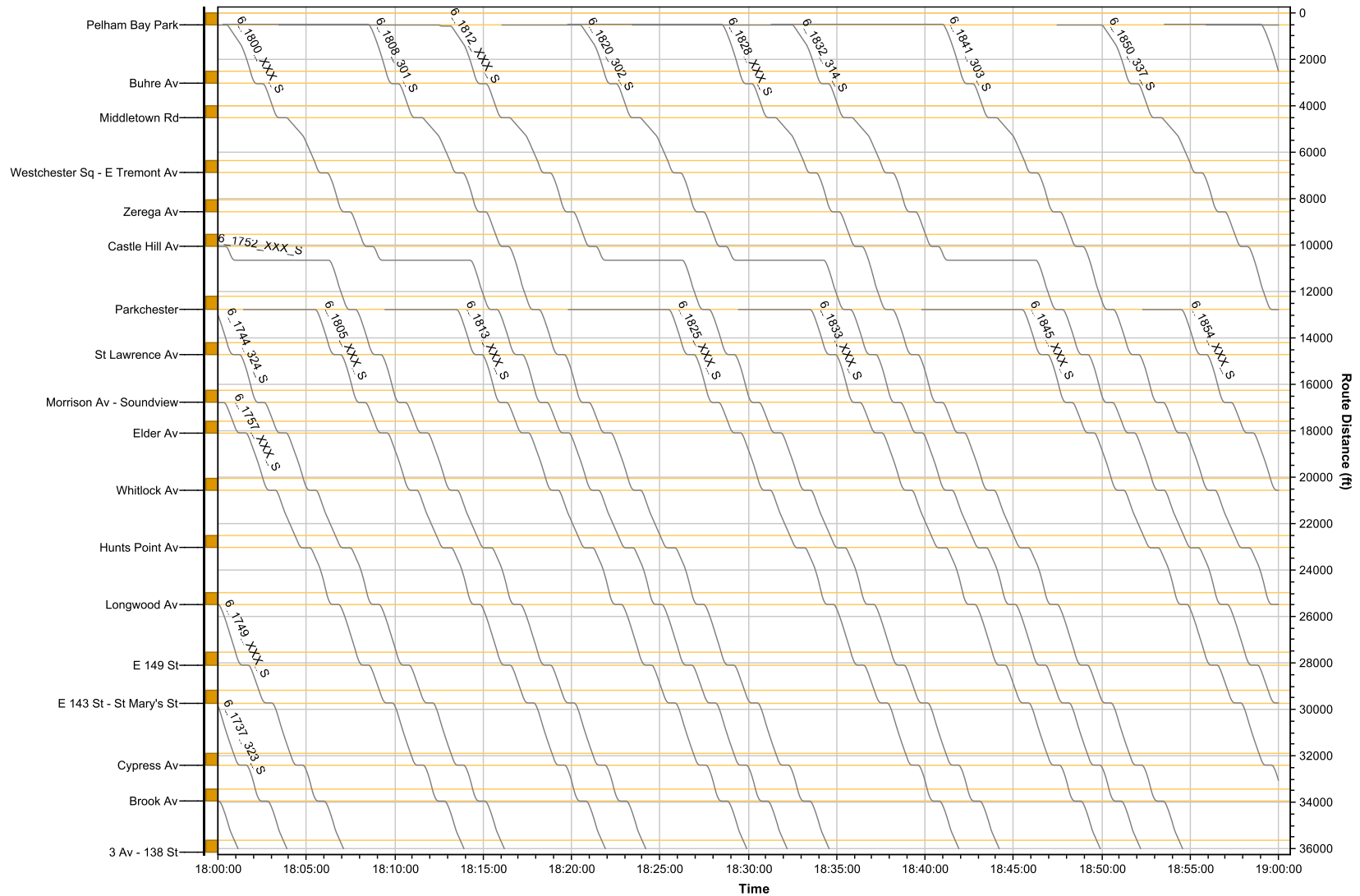
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-79: String Chart – Pelham Bay Park to 3 Avenue-138 Street – Southbound – 5:00 to 6:00 p.m.



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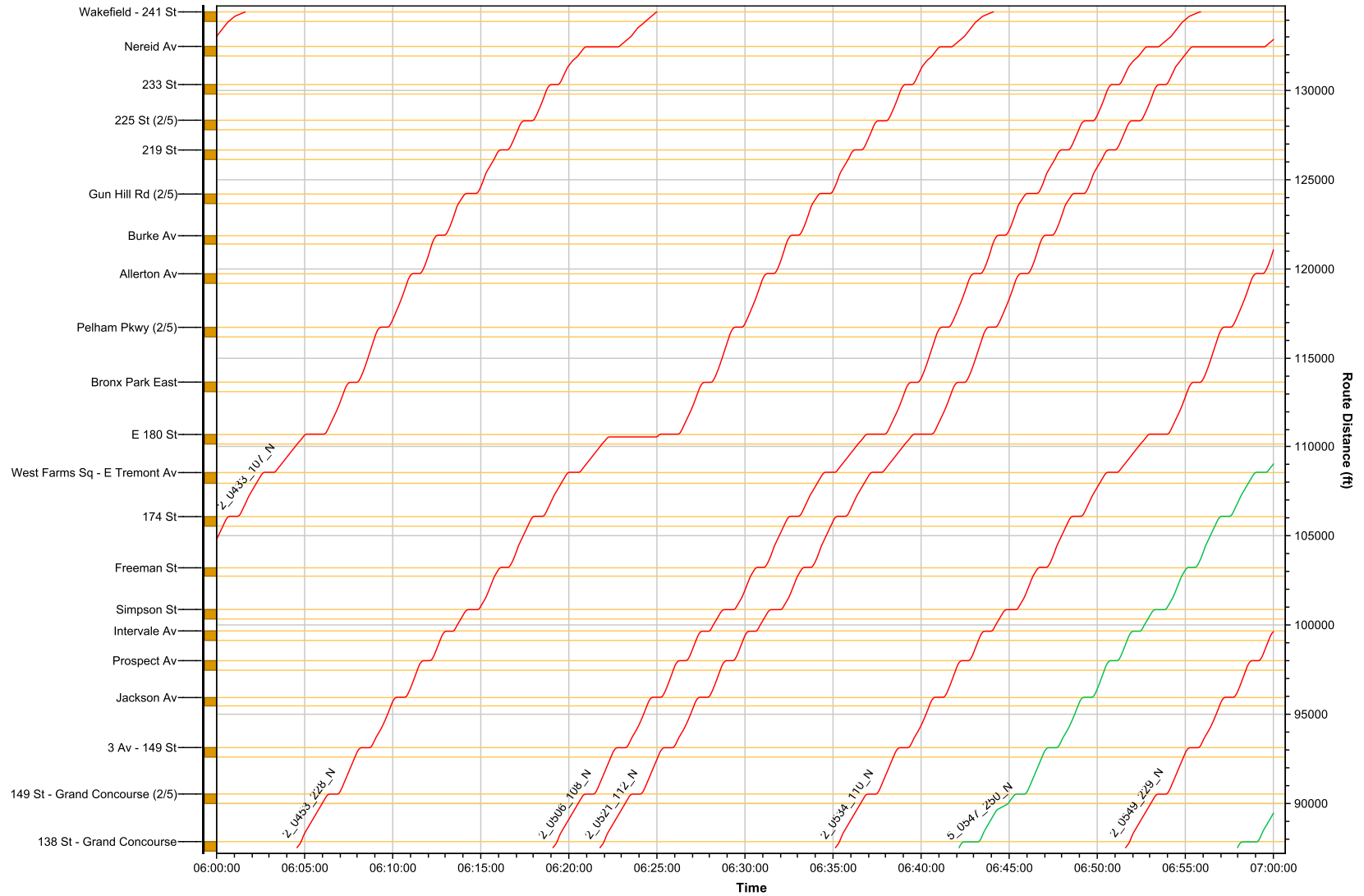
Figure F.3-80: String Chart – Pelham Bay Park to 3 Avenue-138 Street – Southbound – 6:00 to 7:00 p.m.



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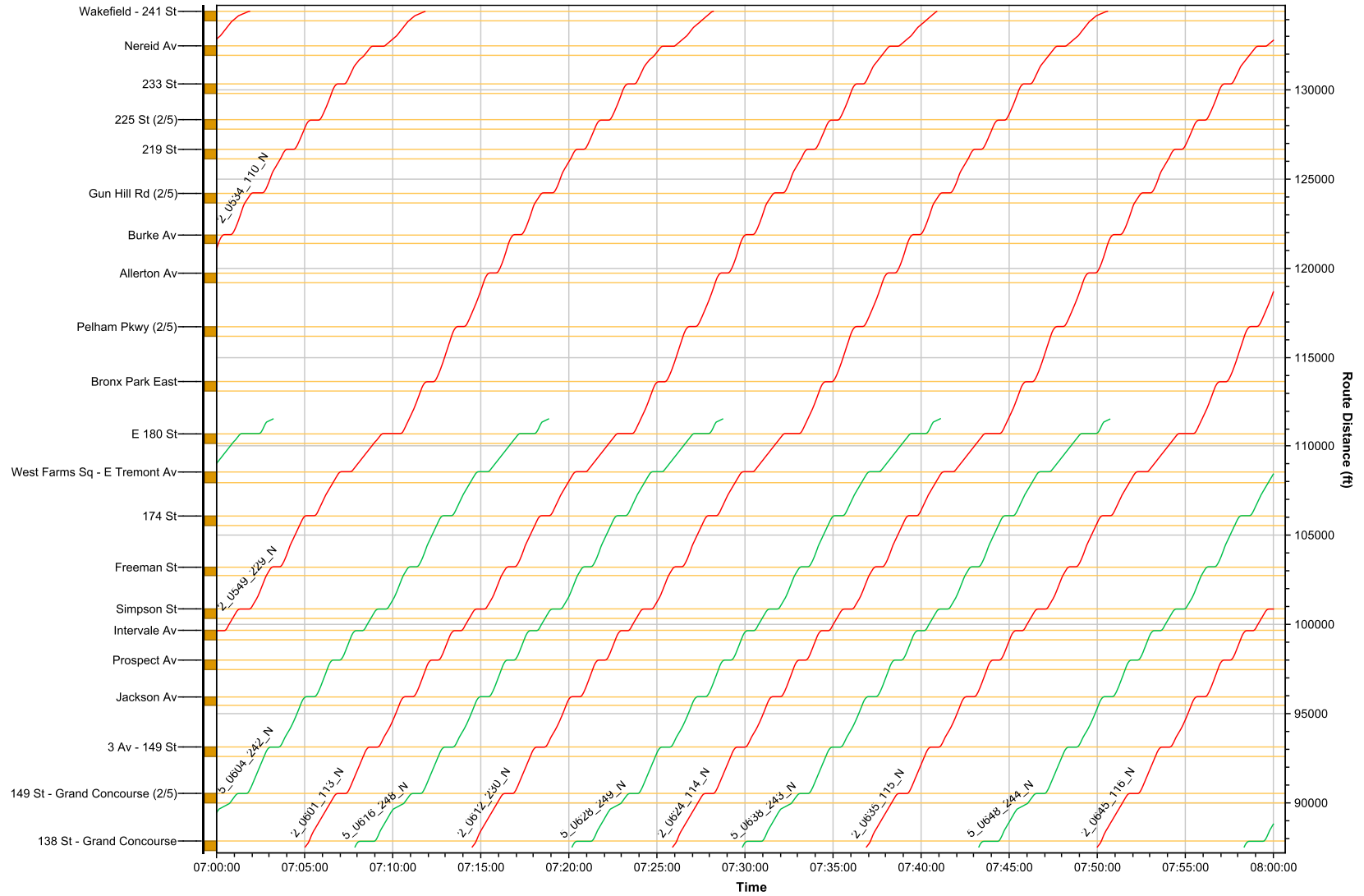
F.3.6 Wakefield-241 Street to 138 Street-Grand Concourse

Figure F.3-81: String Chart – 138 Street-Grand Concourse to Wakefield-241 Street – Northbound – 6:00 to 7:00 a.m.



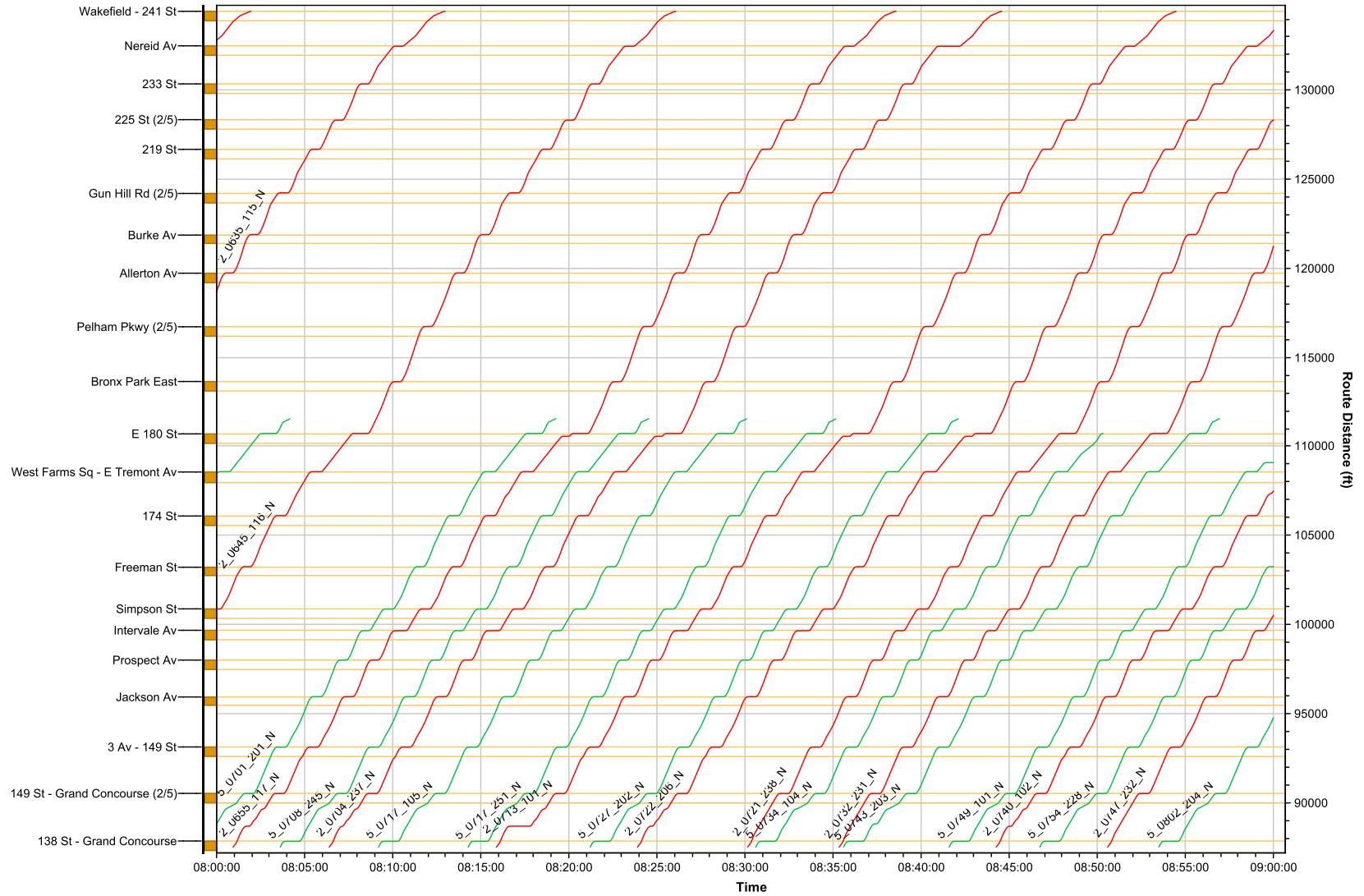
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Figure F.3-82: String Chart – 138 Street-Grand Concourse to Wakefield-241 Street – Northbound – 7:00 to 8:00 a.m.



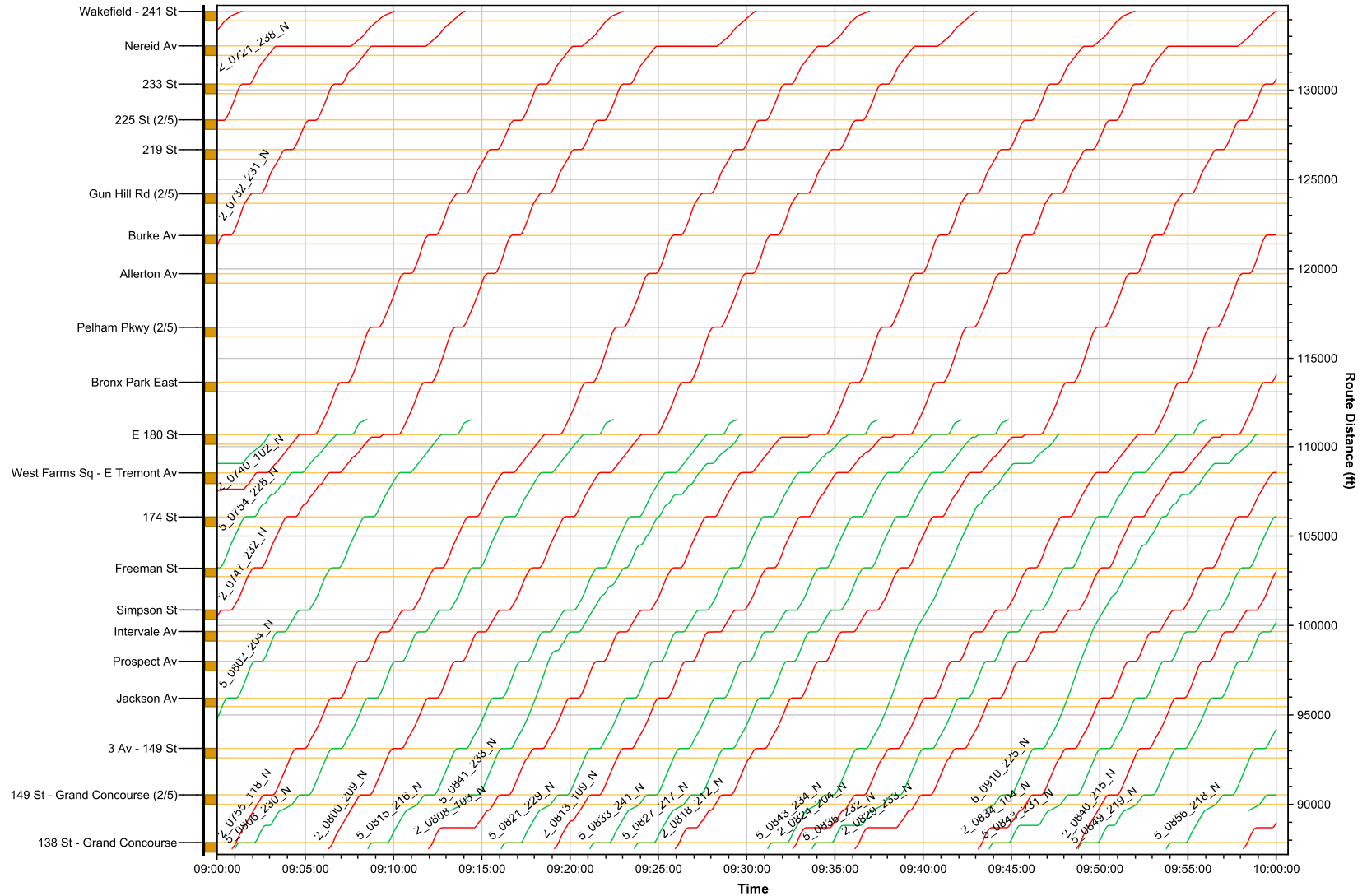
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-83: String Chart – 138 Street-Grand Concourse to Wakefield-241 Street – Northbound – 8:00 to 9:00 a.m.



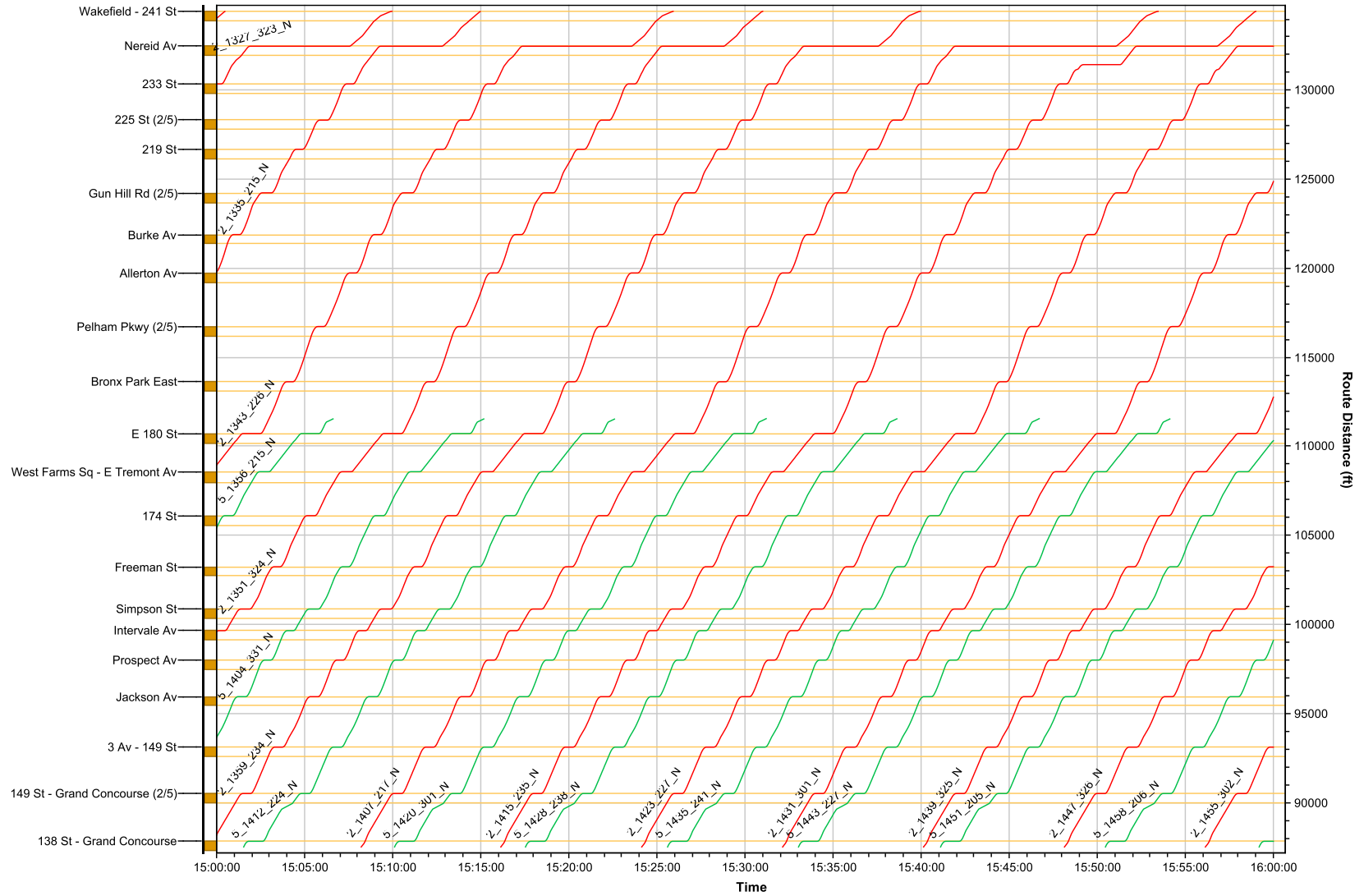
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Figure F.3-84: String Chart – 138 Street-Grand Concourse to Wakefield-241 Street – Northbound – 9:00 to 10:00 a.m.



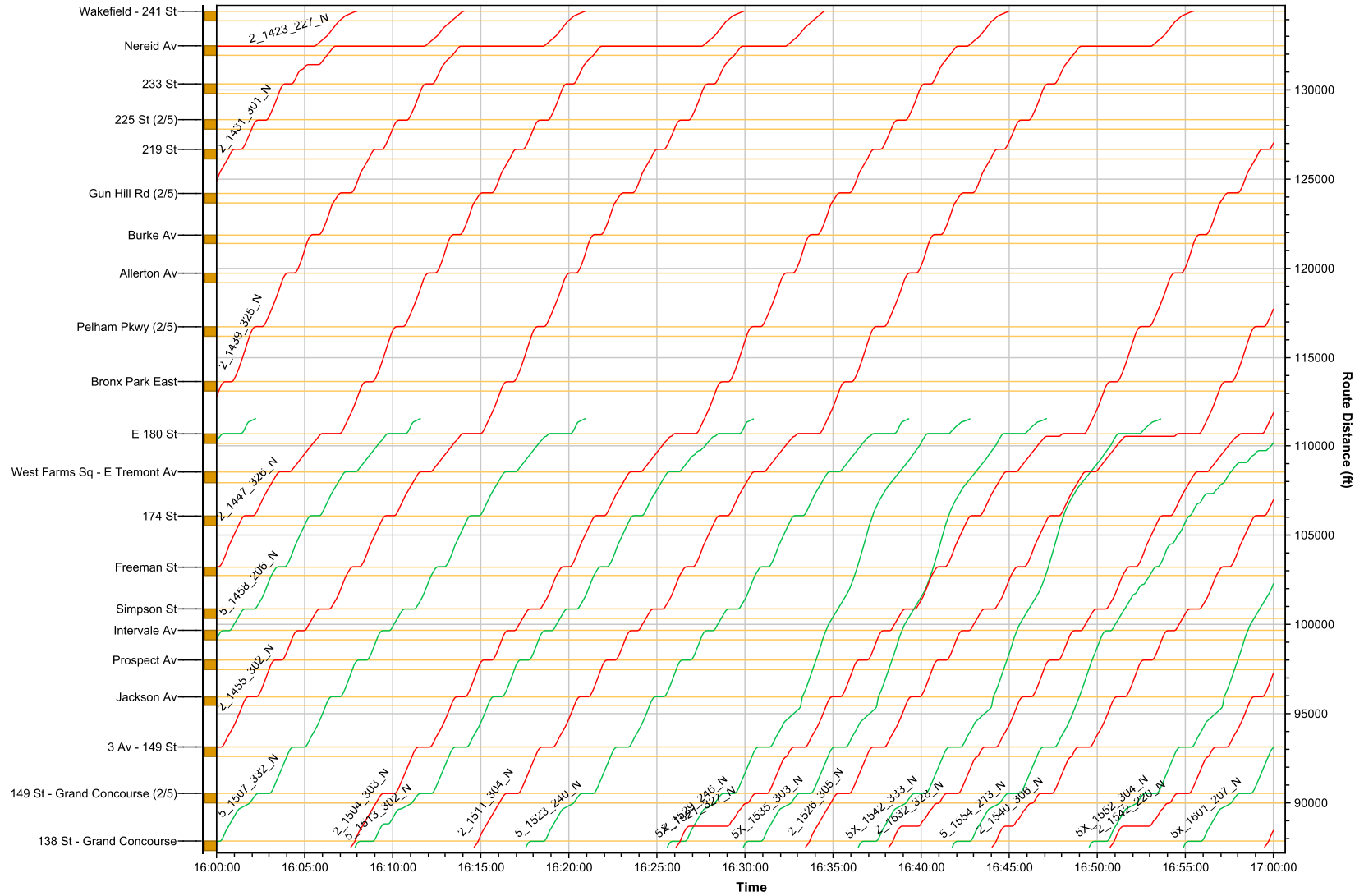
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-85: String Chart – 138 Street-Grand Concourse to Wakefield-241 Street – Northbound – 3:00 to 4:00 p.m.



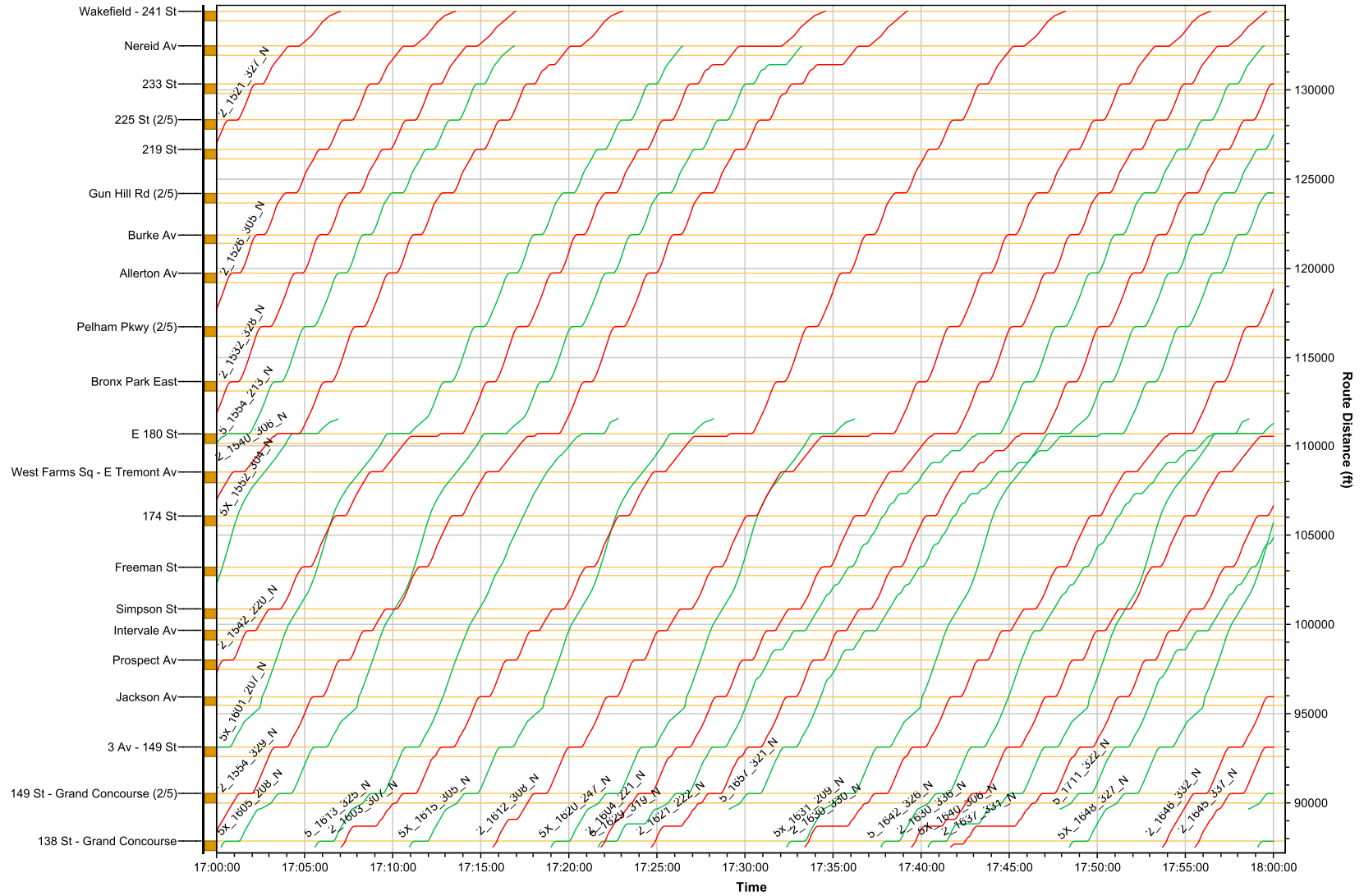
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-86: String Chart – 138 Street-Grand Concourse to Wakefield-241 Street – Northbound – 4:00 to 5:00 p.m.



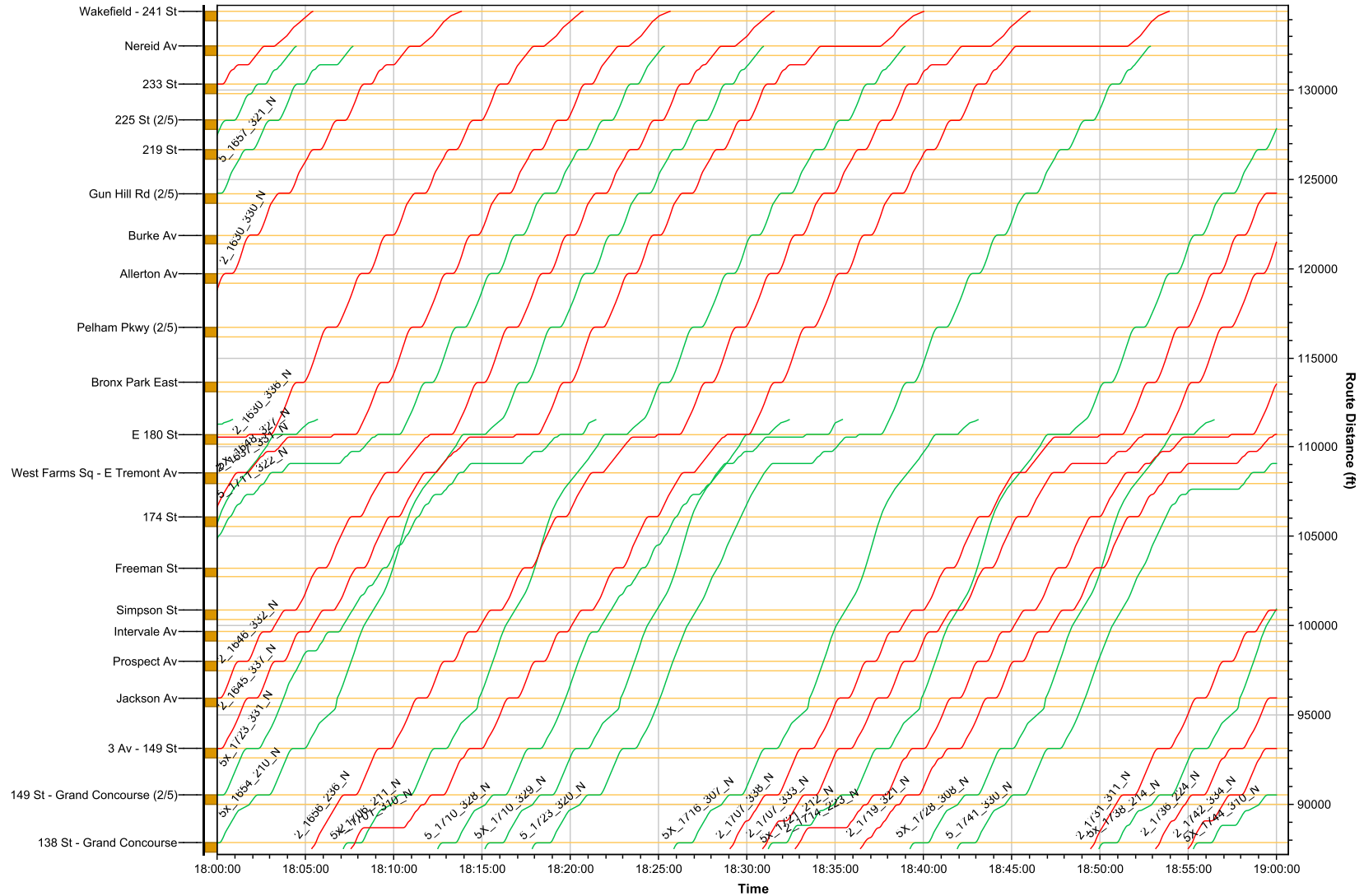
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-87: String Chart – 138 Street-Grand Concourse to Wakefield-241 Street – Northbound – 5:00 to 6:00 p.m.



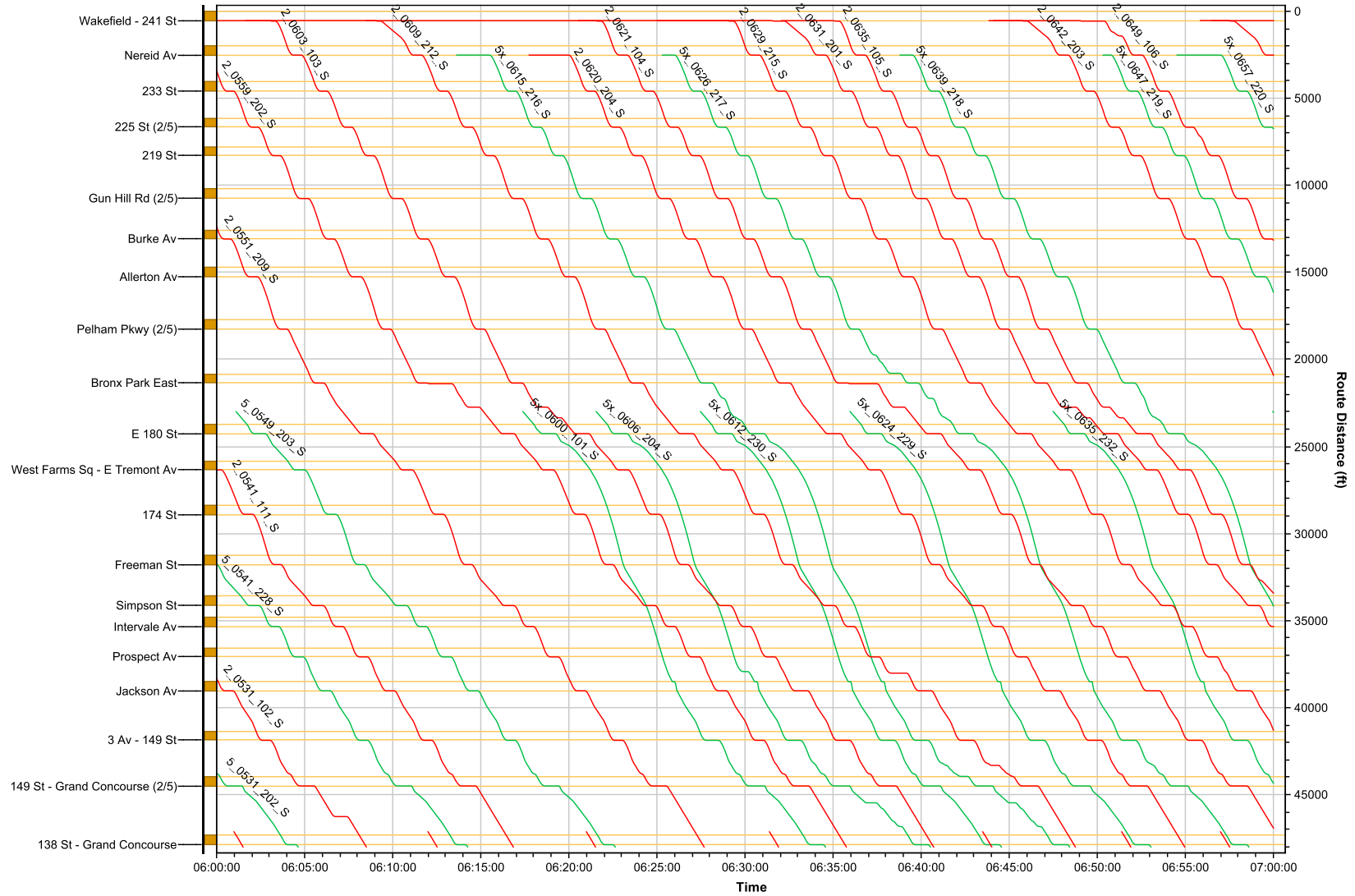
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Figure F.3-88: String Chart – 138 Street-Grand Concourse to Wakefield-241 Street – Northbound – 6:00 to 7:00 p.m.



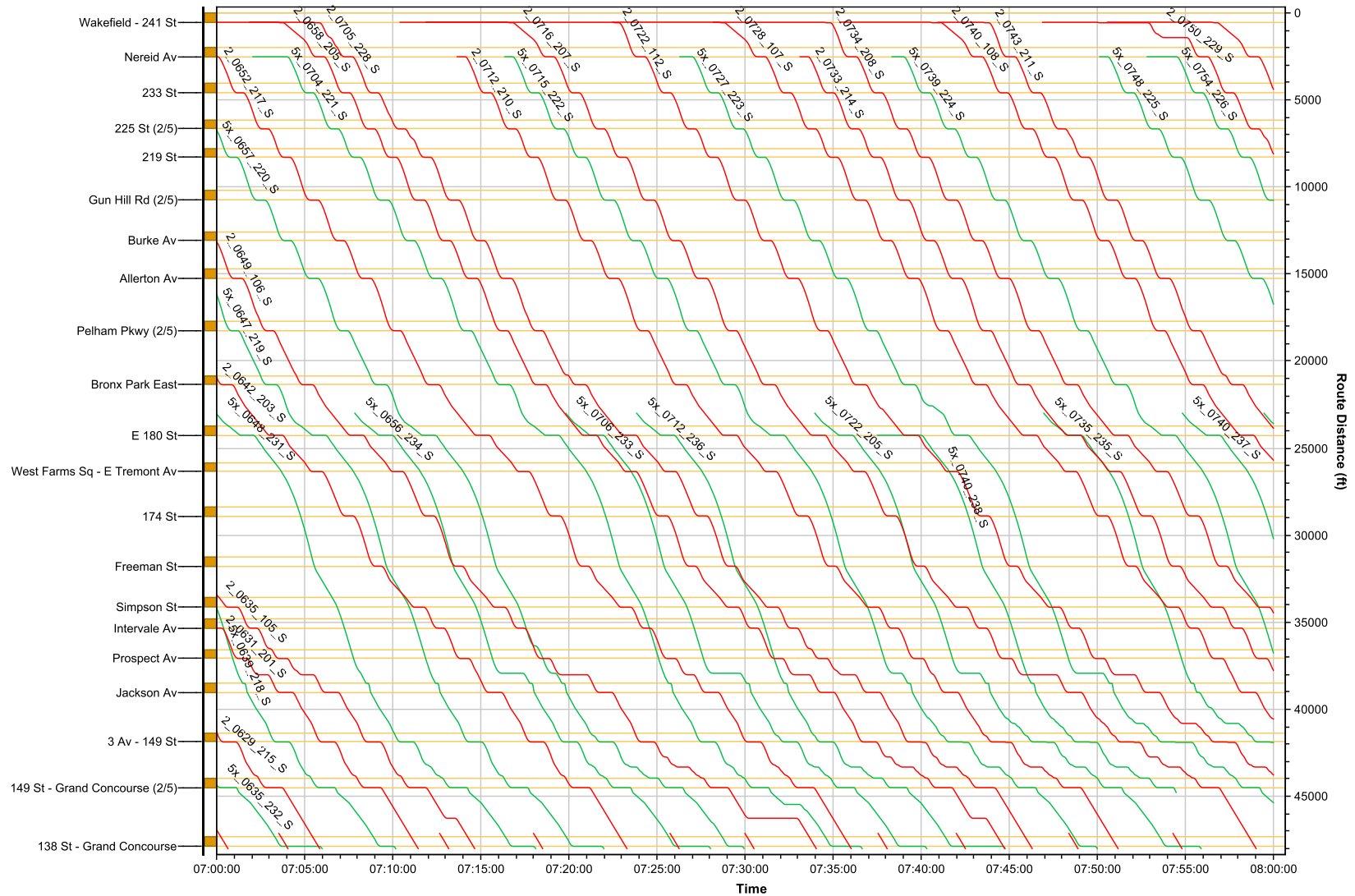
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Figure F.3-89: String Chart – Wakefield-241 Street to 138 Street-Grand Concourse – Southbound – 6:00 to 7:00 a.m.



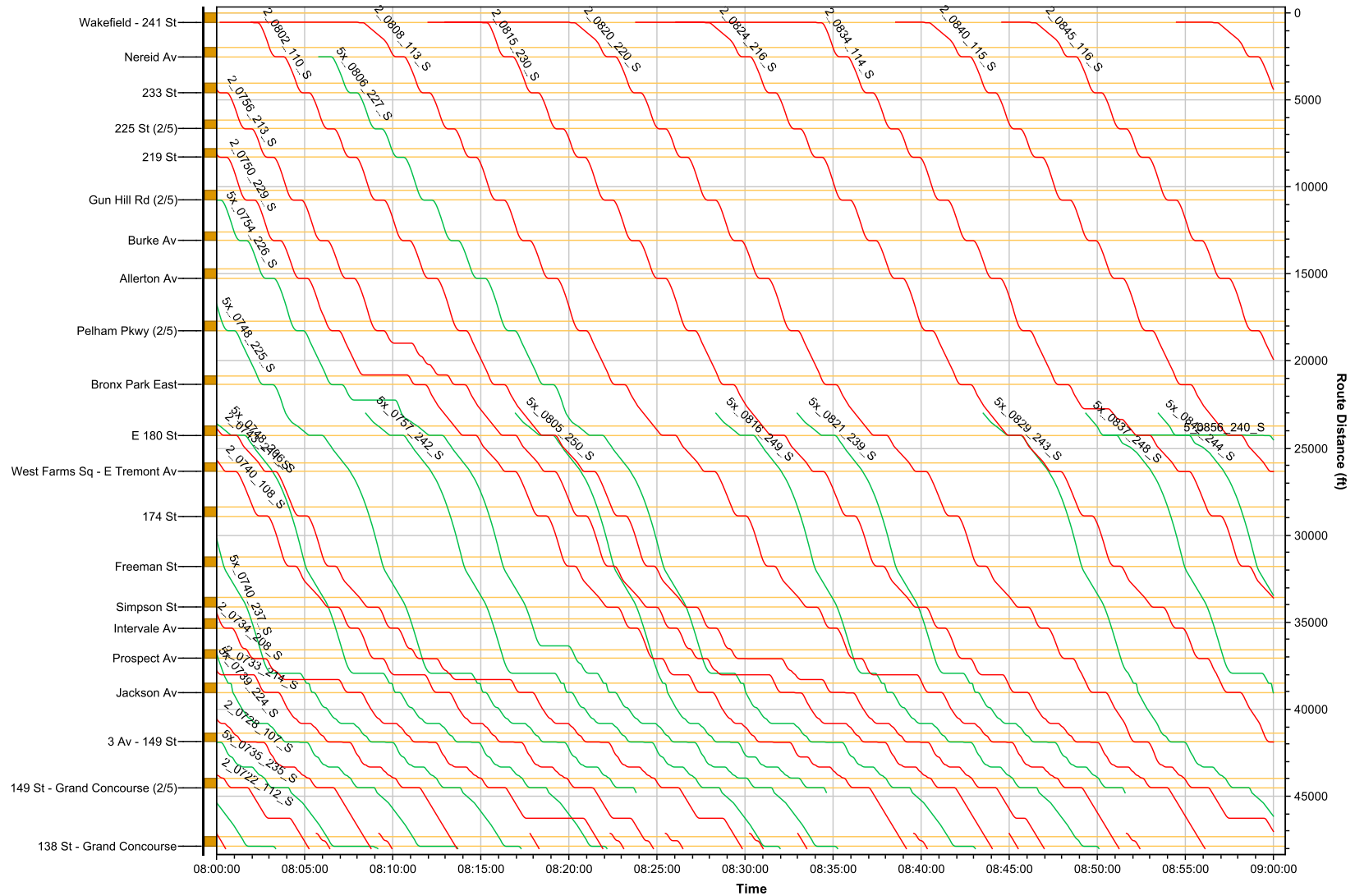
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-90: String Chart – Wakefield-241 Street to 138 Street-Grand Concourse – Southbound – 7:00 to 8:00 a.m.



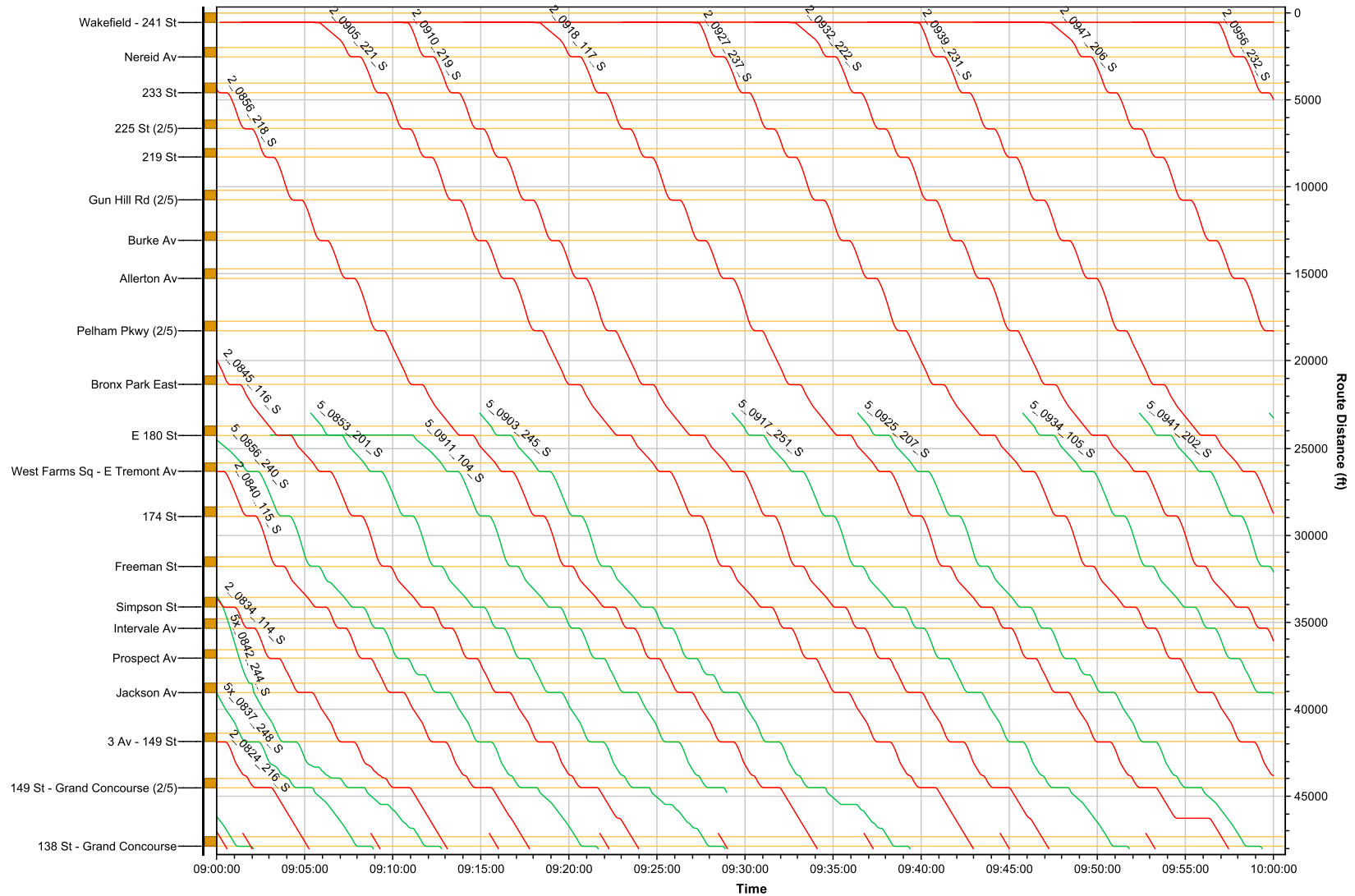
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Figure F.3-91: String Chart – Wakefield-241 Street to 138 Street-Grand Concourse – Southbound – 8:00 to 9:00 a.m.



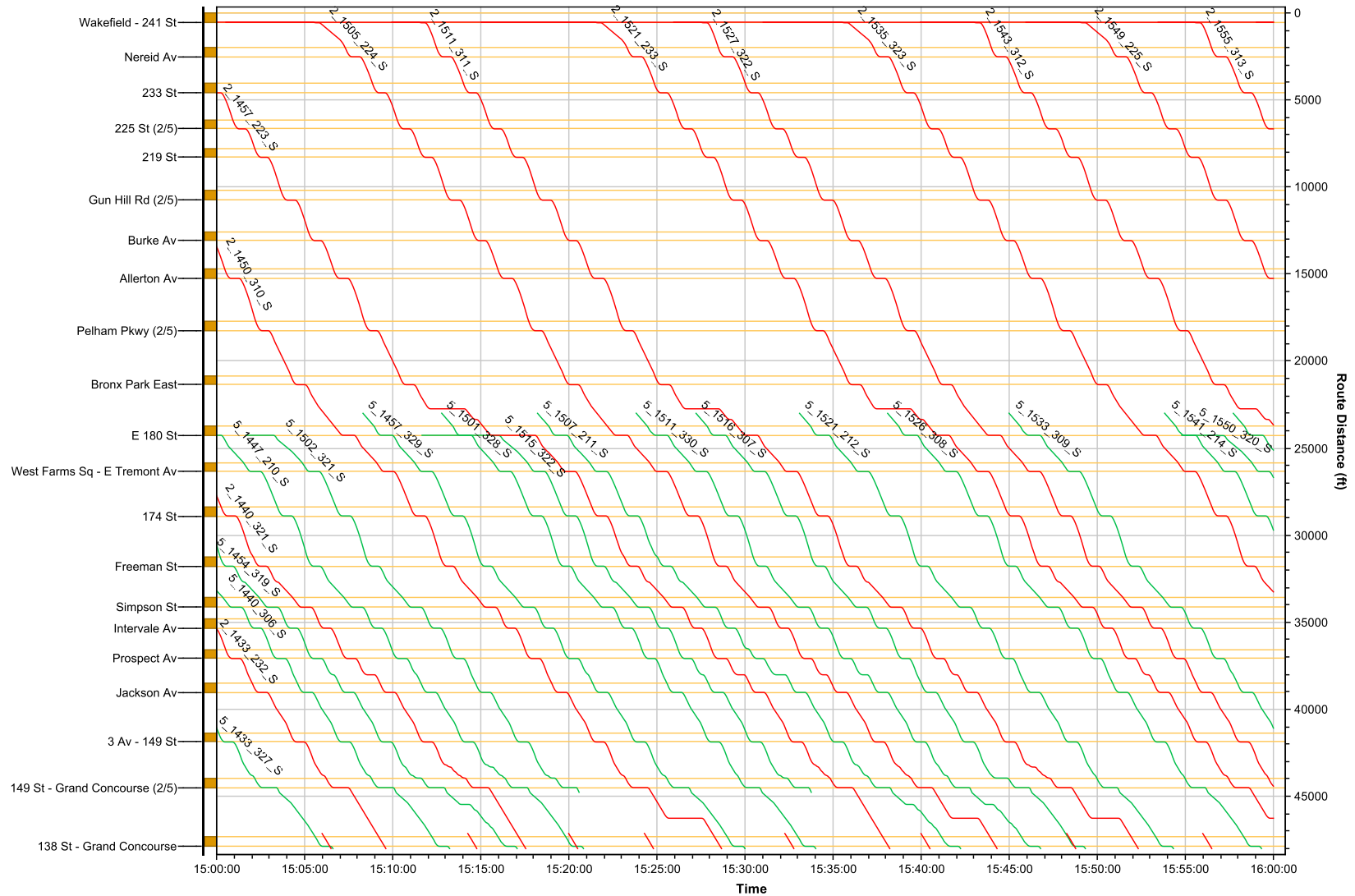
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Figure F.3-92: String Chart – Wakefield-241 Street to 138 Street-Grand Concourse – Southbound – 9:00 to 10:00 a.m.



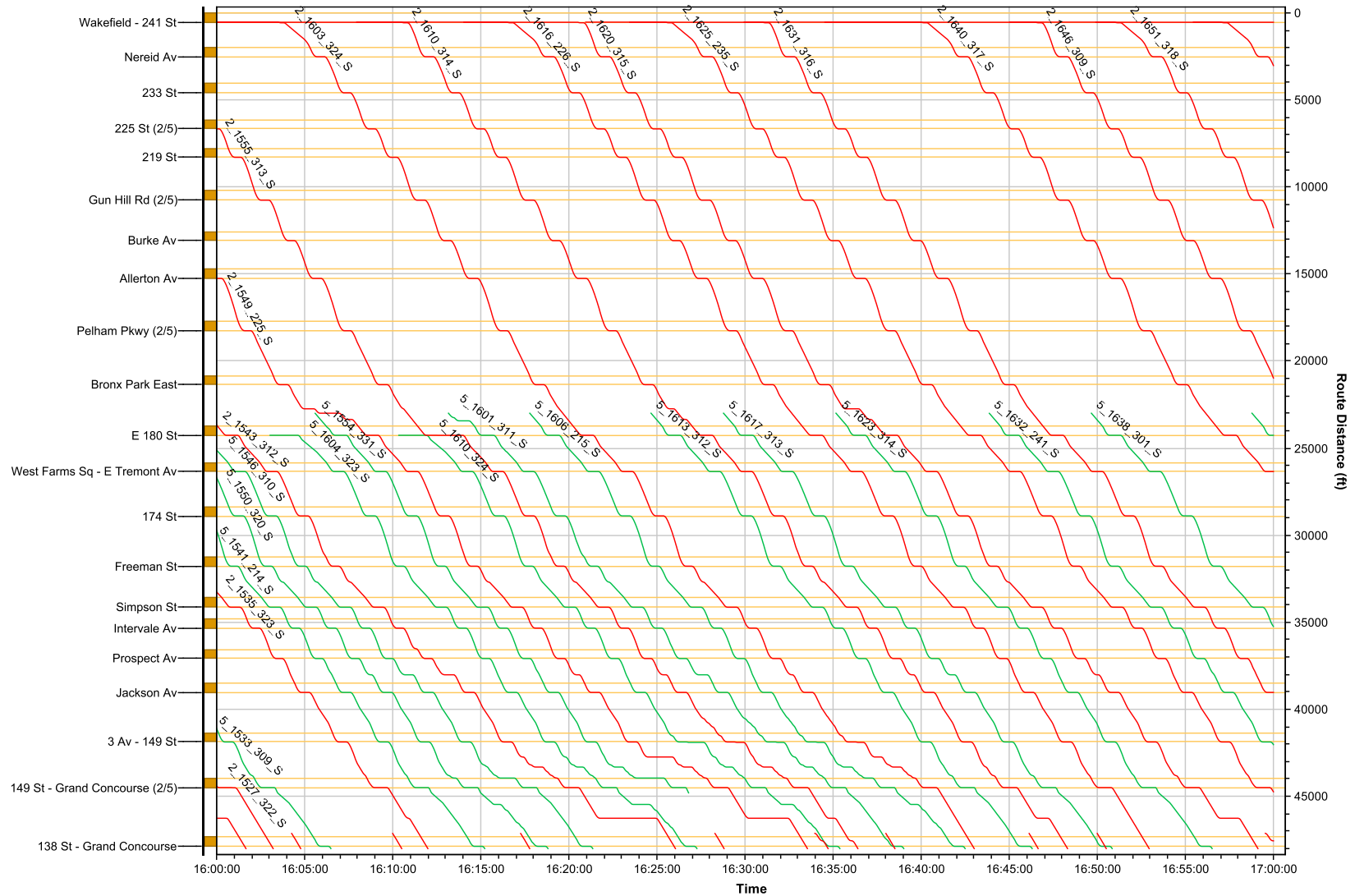
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Figure F.3-93: String Chart – Wakefield-241 Street to 138 Street-Grand Concourse – Southbound – 3:00 to 4:00 p.m.



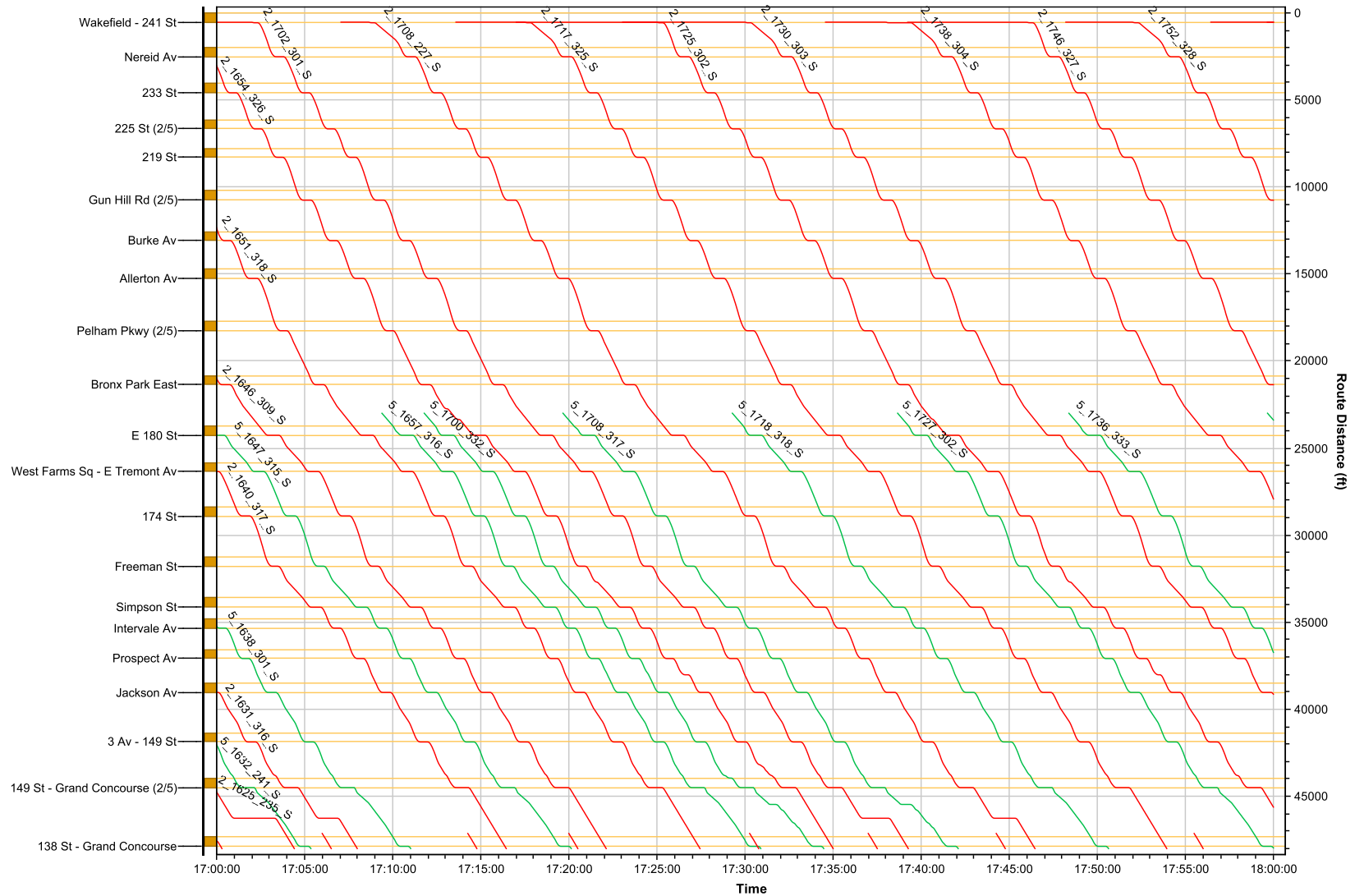
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Figure F.3-94: String Chart – Wakefield-241 Street to 138 Street-Grand Concourse – Southbound – 4:00 to 5:00 p.m.



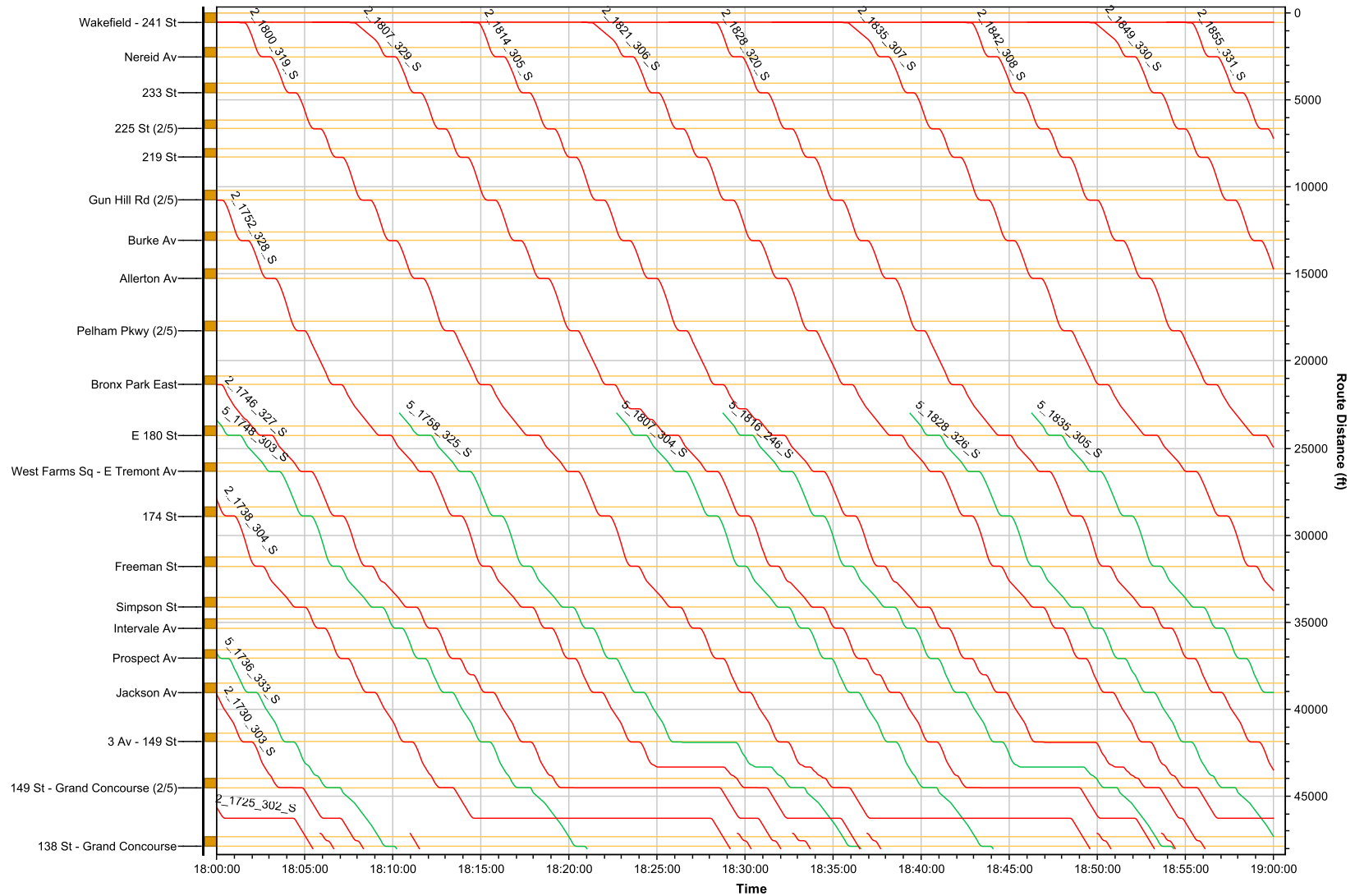
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Figure F.3-95: String Chart – Wakefield-241 Street to 138 Street-Grand Concourse – Southbound – 5:00 to 6:00 p.m.



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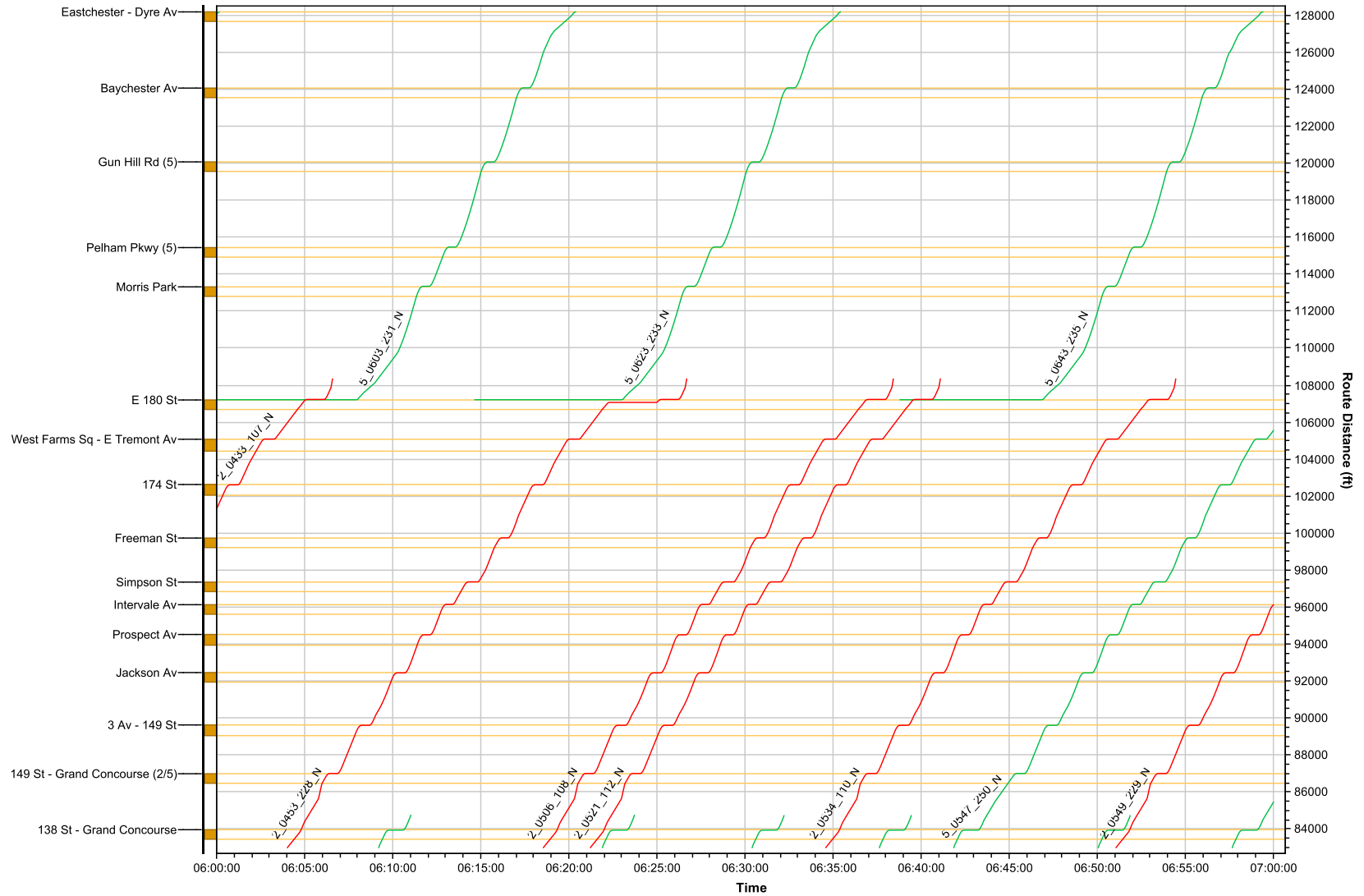
Figure F.3-96: String Chart – Wakefield-241 Street to 138 Street-Grand Concourse – Southbound – 6:00 to 7:00 p.m.



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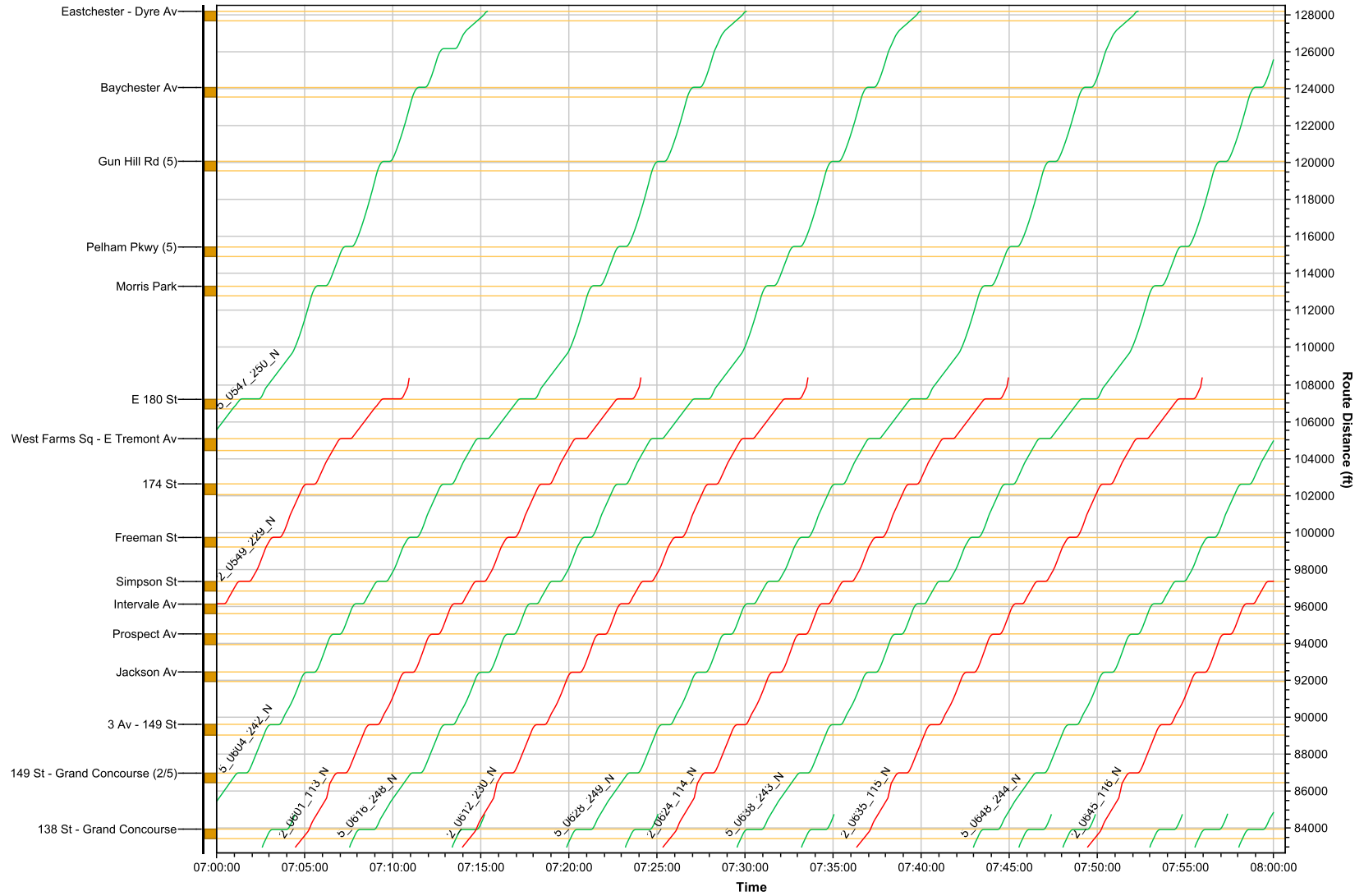
F.3.7 Eastchester-Dyre Avenue to 138 Street-Grand Concourse

Figure F.3-97: String Chart – 138 Street-Grand Concourse to Eastchester-Dyre Avenue – Northbound – 6:00 to 7:00 a.m.



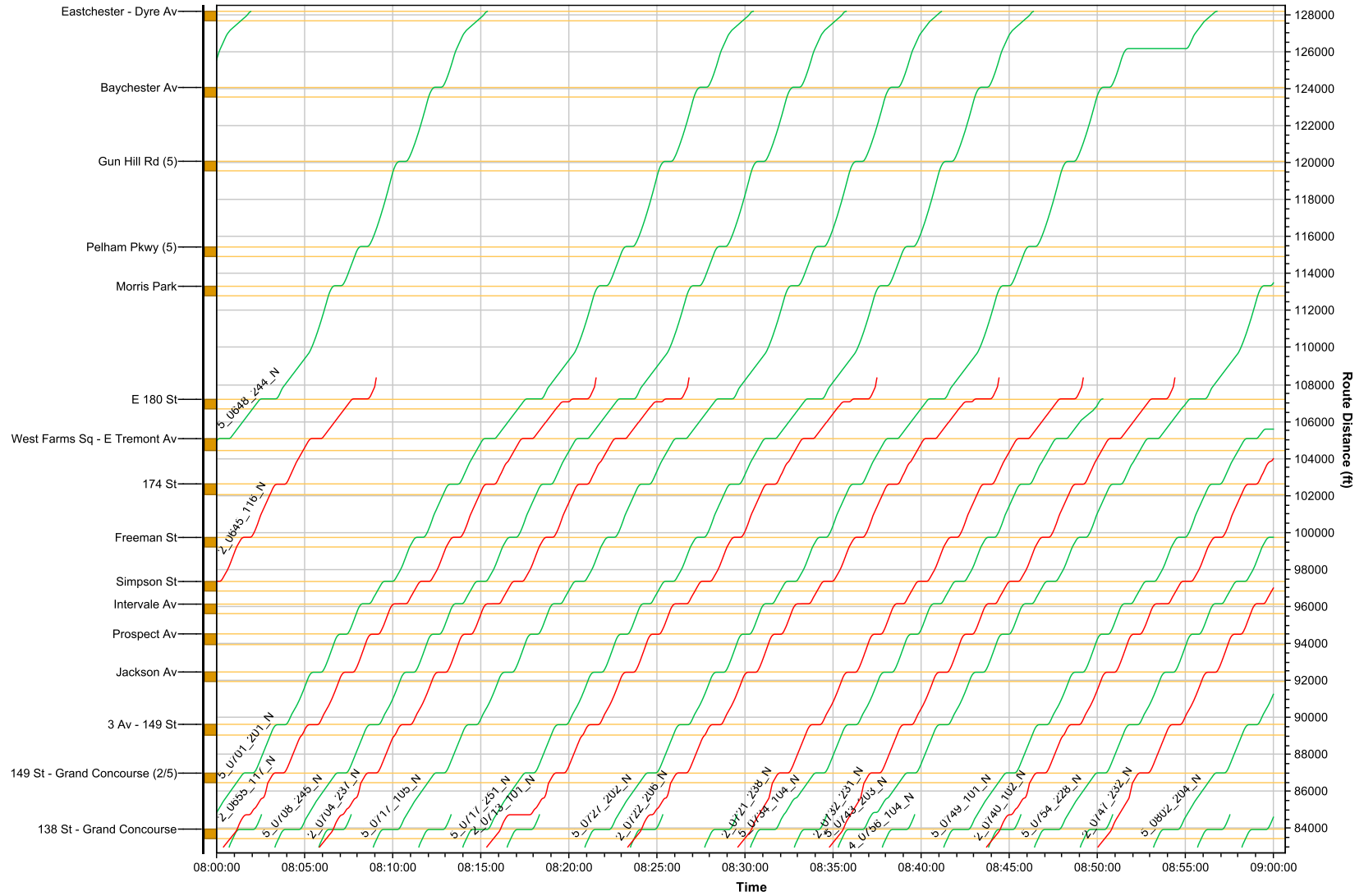
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Figure F.3-98: String Chart – 138 Street-Grand Concourse to Eastchester-Dyre Avenue – Northbound – 7:00 to 8:00 a.m.



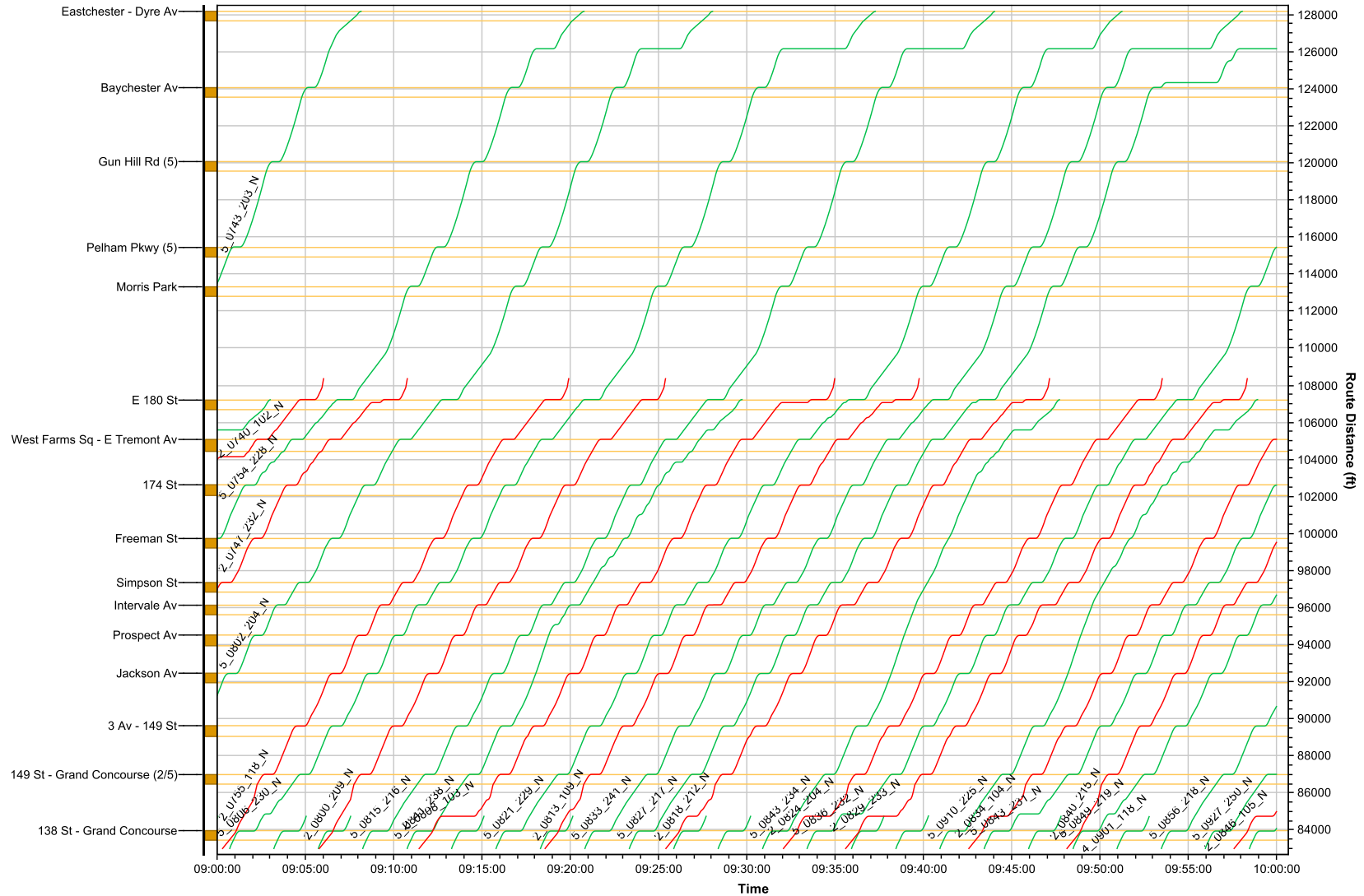
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Figure F.3-99: String Chart – 138 Street-Grand Concourse to Eastchester-Dyre Avenue – Northbound – 8:00 to 9:00 a.m.



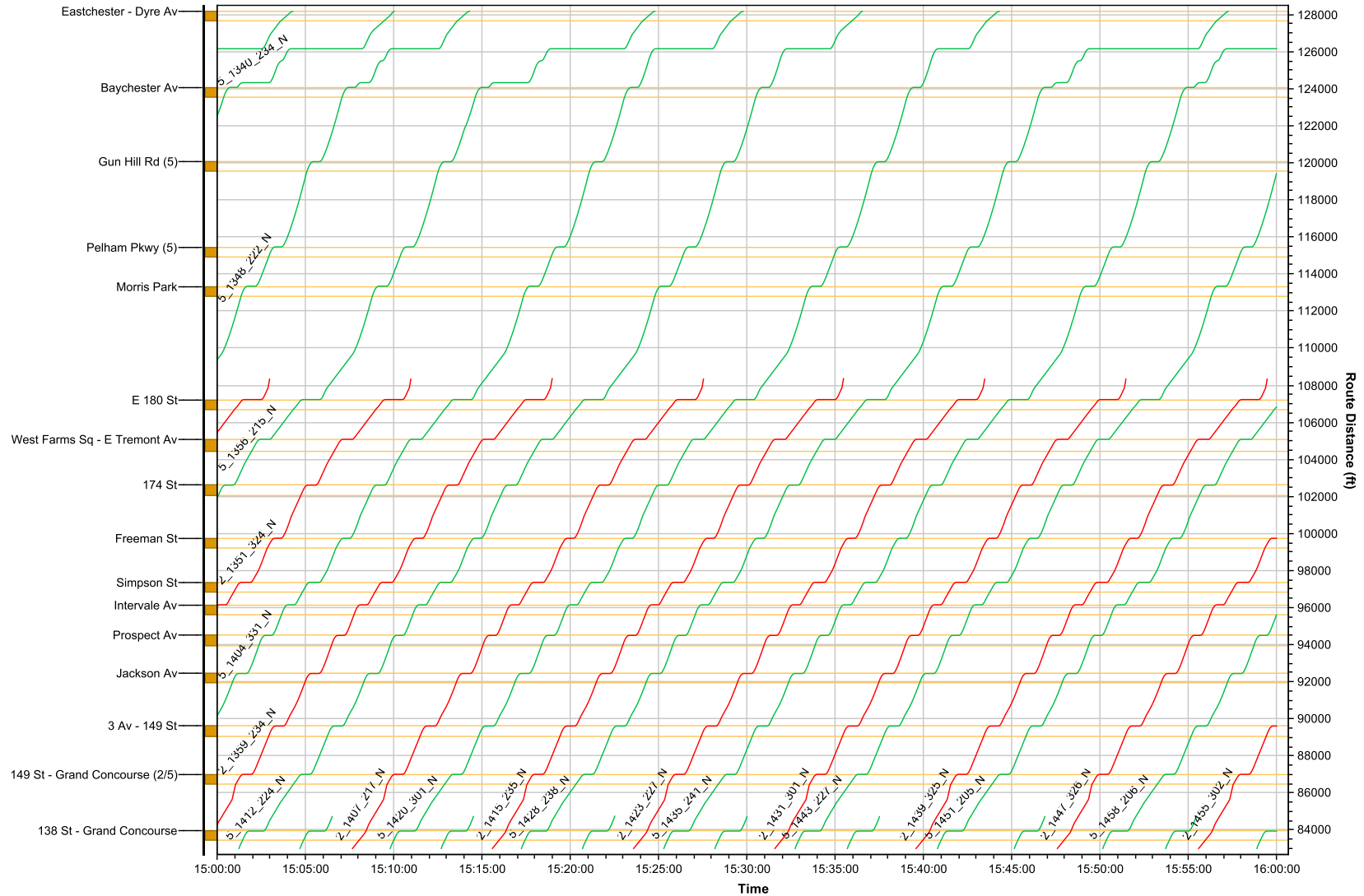
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Figure F.3-100: String Chart – 138 Street-Grand Concourse to Eastchester-Dyre Avenue – Northbound – 9:00 to 10:00 a.m.



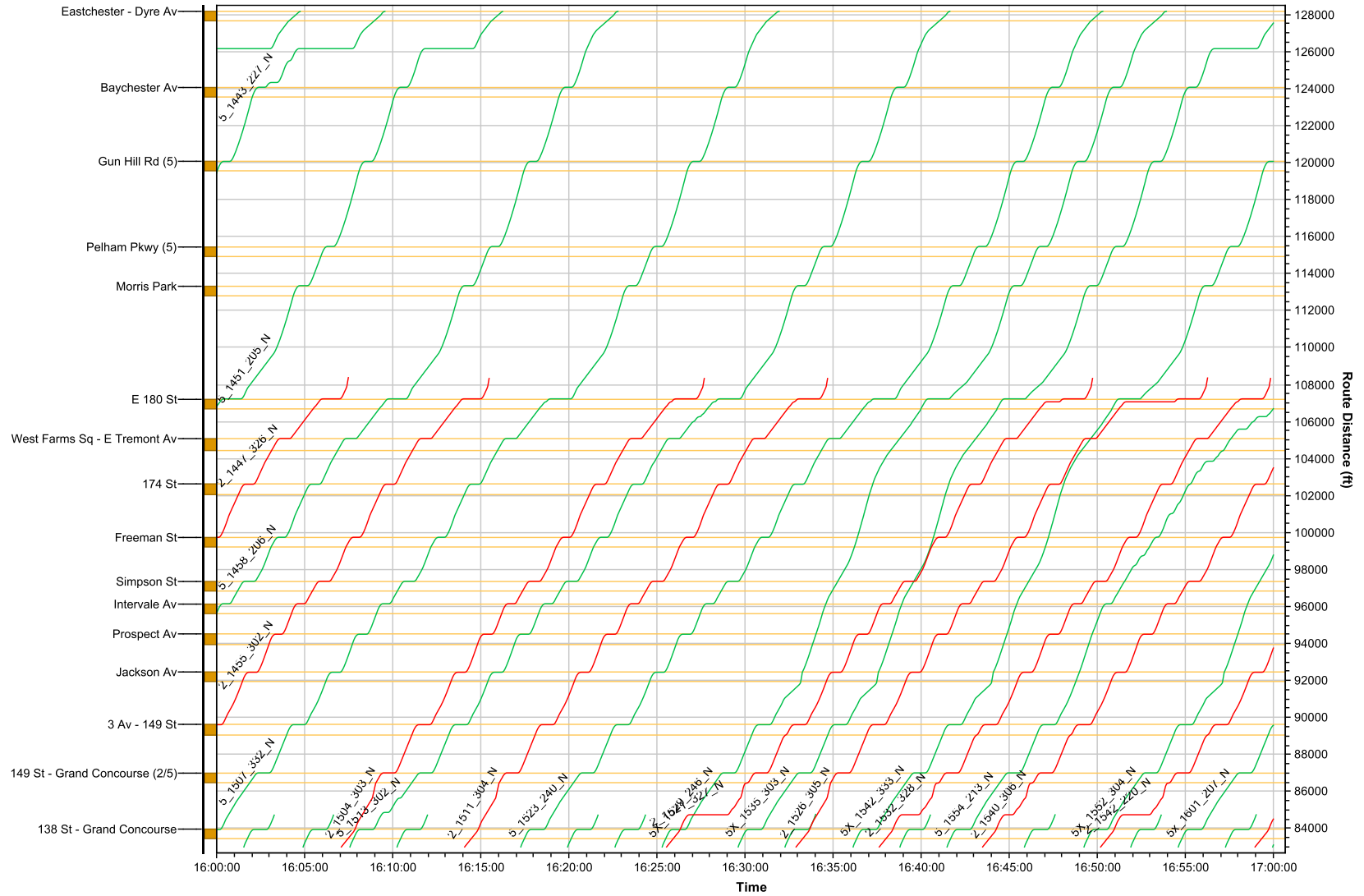
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Figure F.3-101: String Chart – 138 Street-Grand Concourse to Eastchester-Dyre Avenue – Northbound – 3:00 to 4:00 p.m.



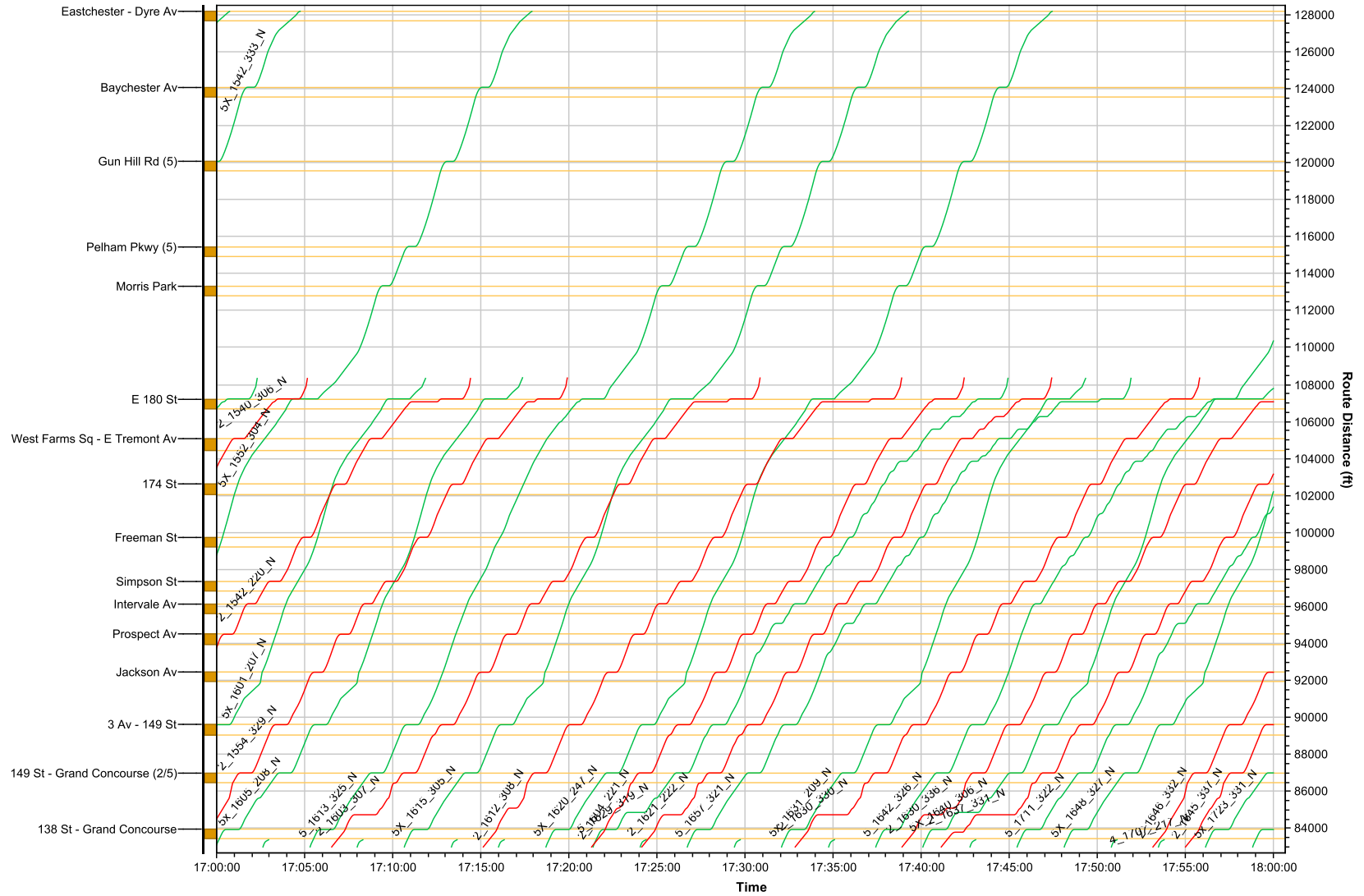
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Figure F.3-102: String Chart – 138 Street-Grand Concourse to Eastchester-Dyre Avenue – Northbound – 4:00 to 5:00 p.m.



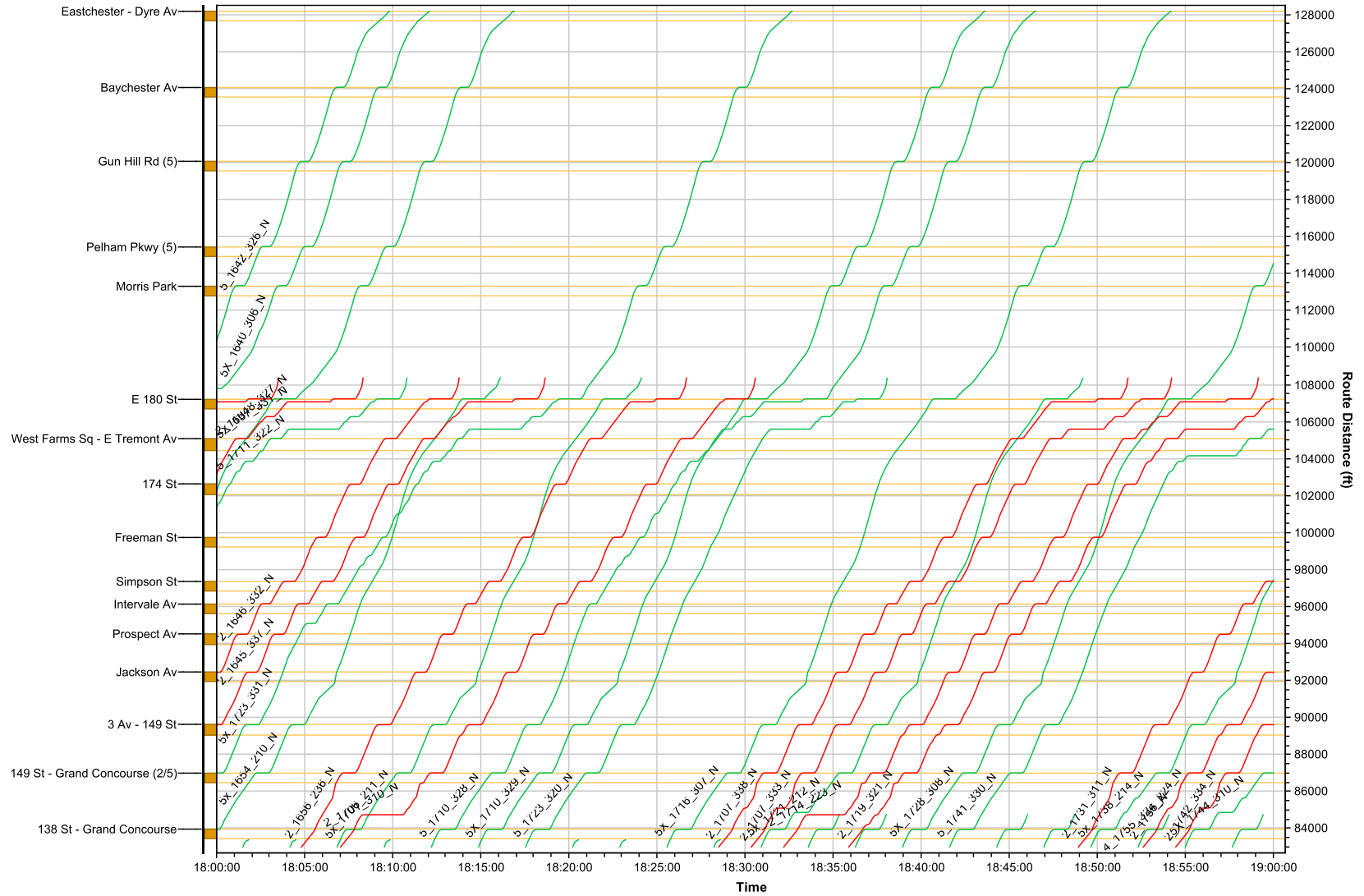
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Figure F.3-103: String Chart – 138 Street-Grand Concourse to Eastchester-Dyre Avenue – Northbound – 5:00 to 6:00 p.m.



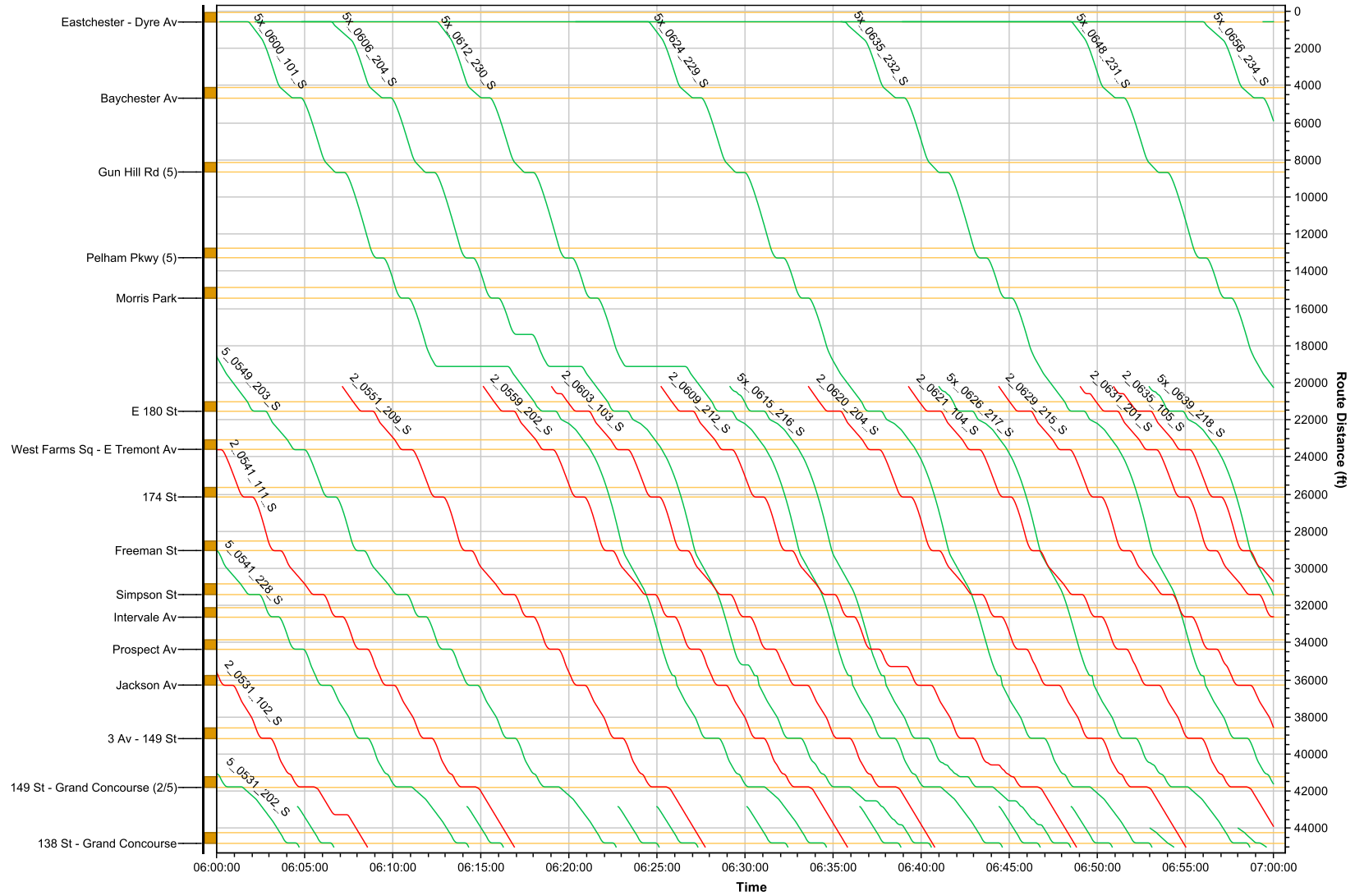
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Figure F.3-104: String Chart – 138 Street-Grand Concourse to Eastchester-Dyre Avenue – Northbound – 6:00 to 7:00 p.m.



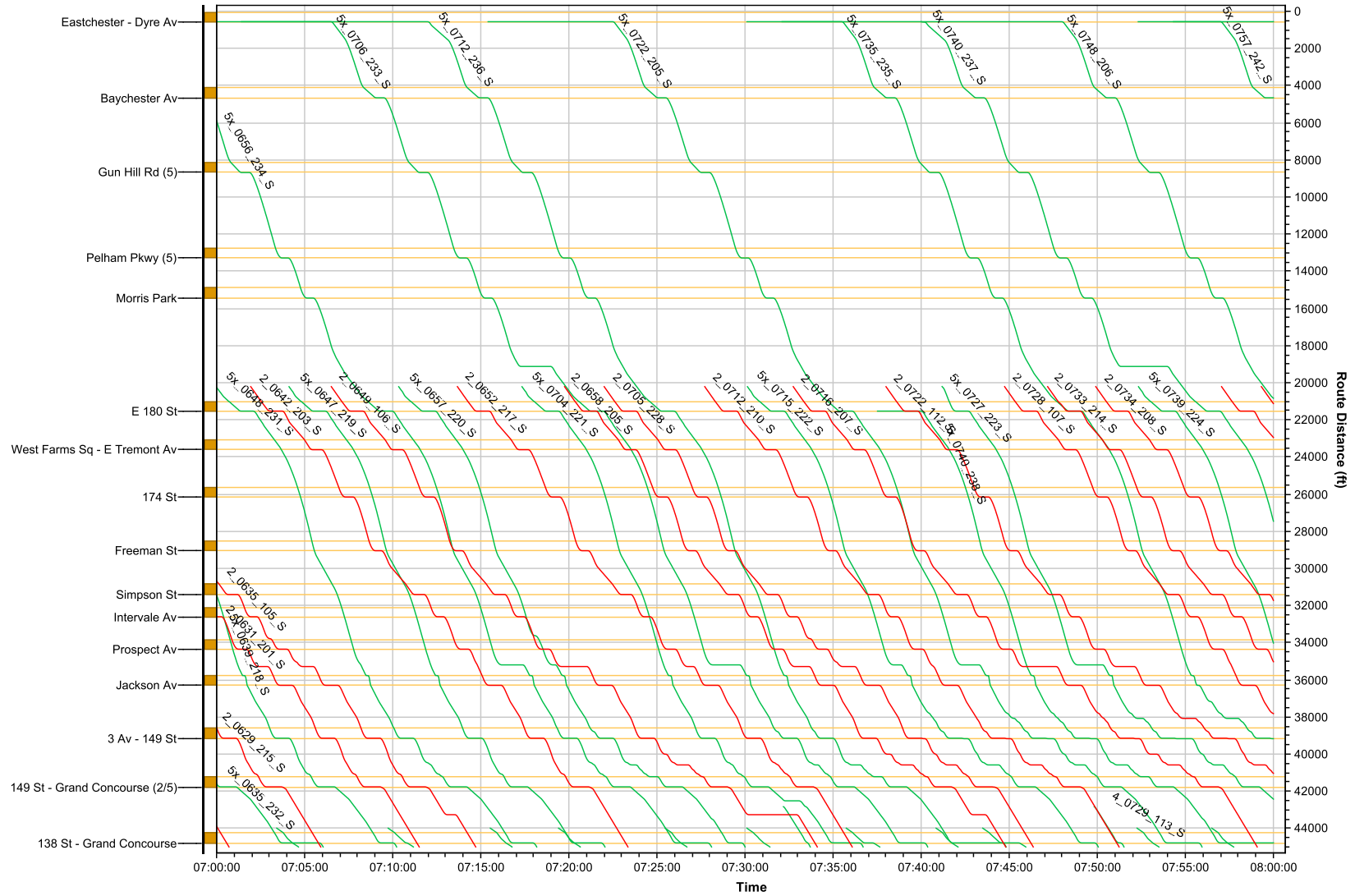
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Figure F.3-105: String Chart – Eastchester-Dyre Avenue to 138 Street-Grand Concourse – Southbound – 6:00 to 7:00 a.m.



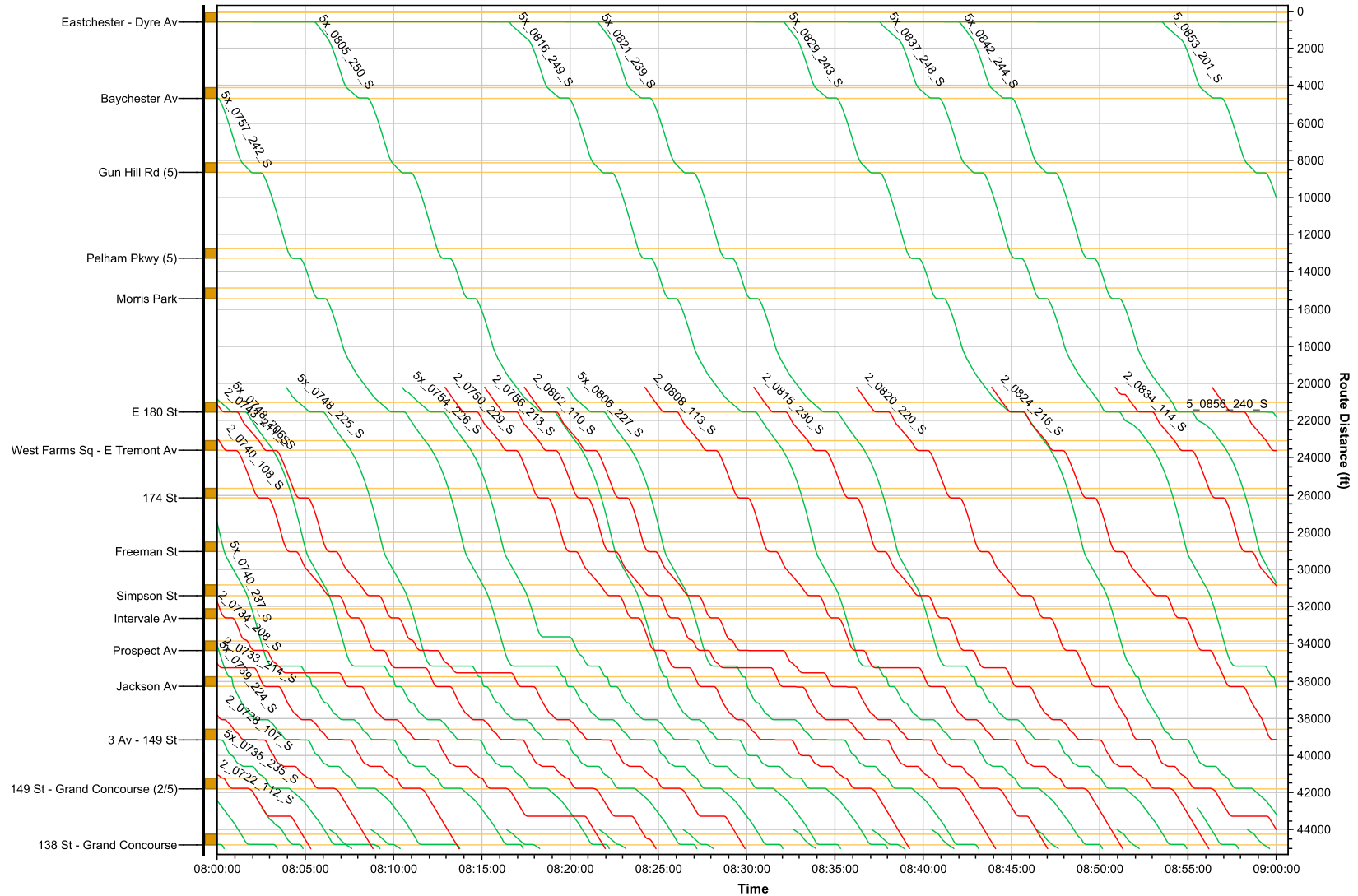
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Figure F.3-106: String Chart – Eastchester-Dyre Avenue to 138 Street-Grand Concourse – Southbound – 7:00 to 8:00 a.m.



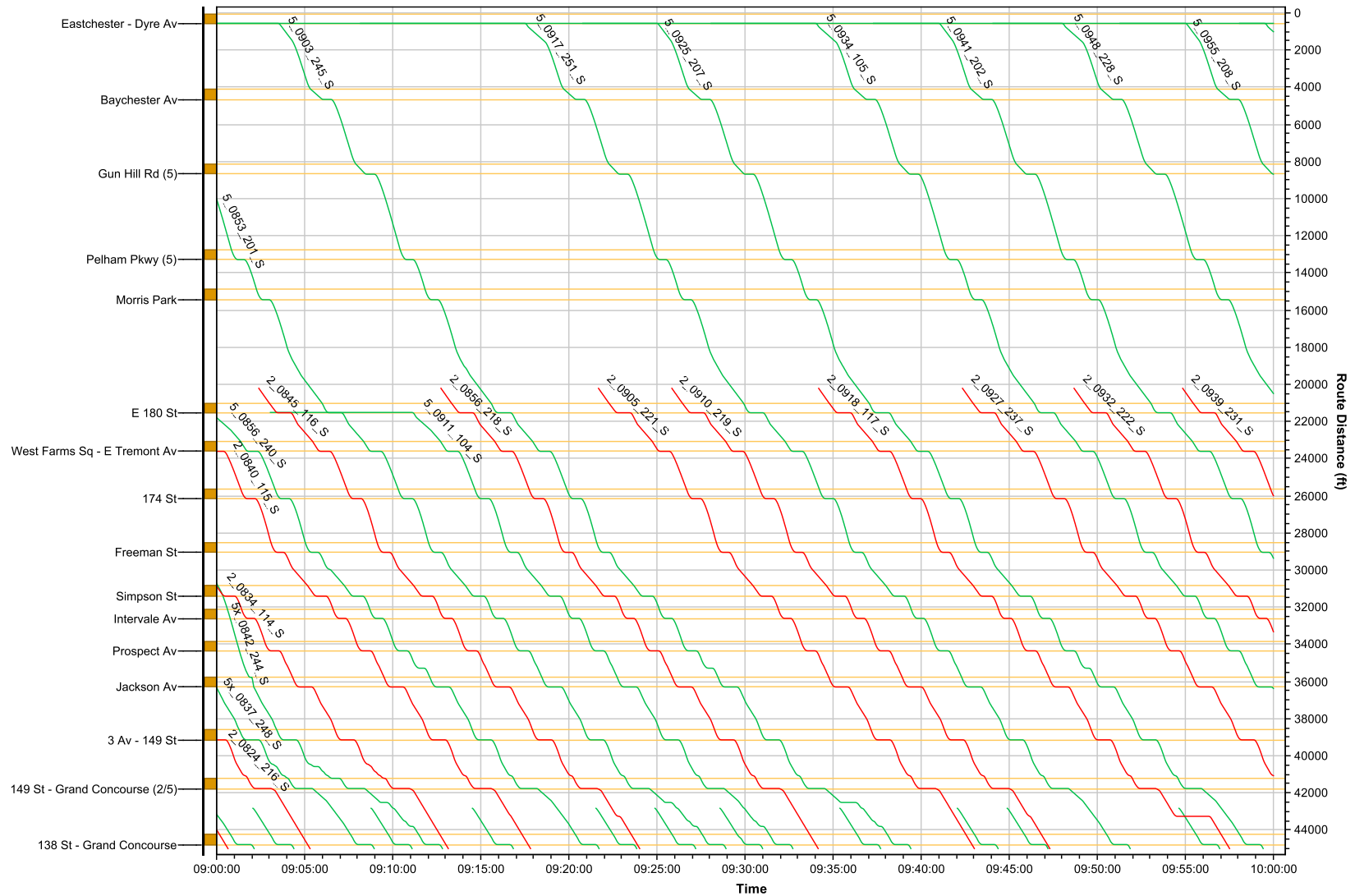
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Figure F.3-107: String Chart – Eastchester-Dyre Avenue to 138 Street-Grand Concourse – Southbound – 8:00 to 9:00 a.m.



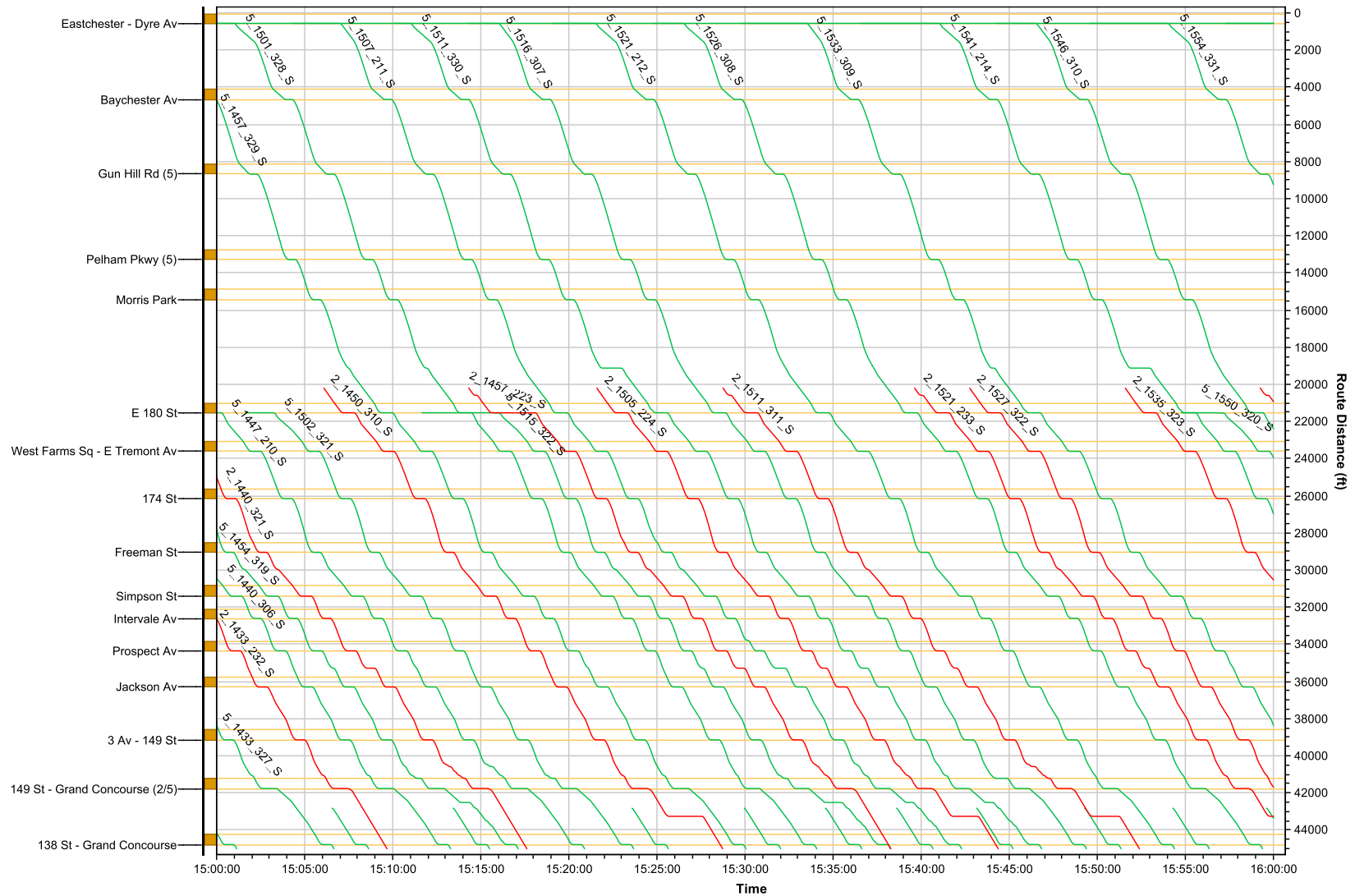
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Figure F.3-108: String Chart – Eastchester-Dyre Avenue to 138 Street-Grand Concourse – Southbound – 9:00 to 10:00 a.m.



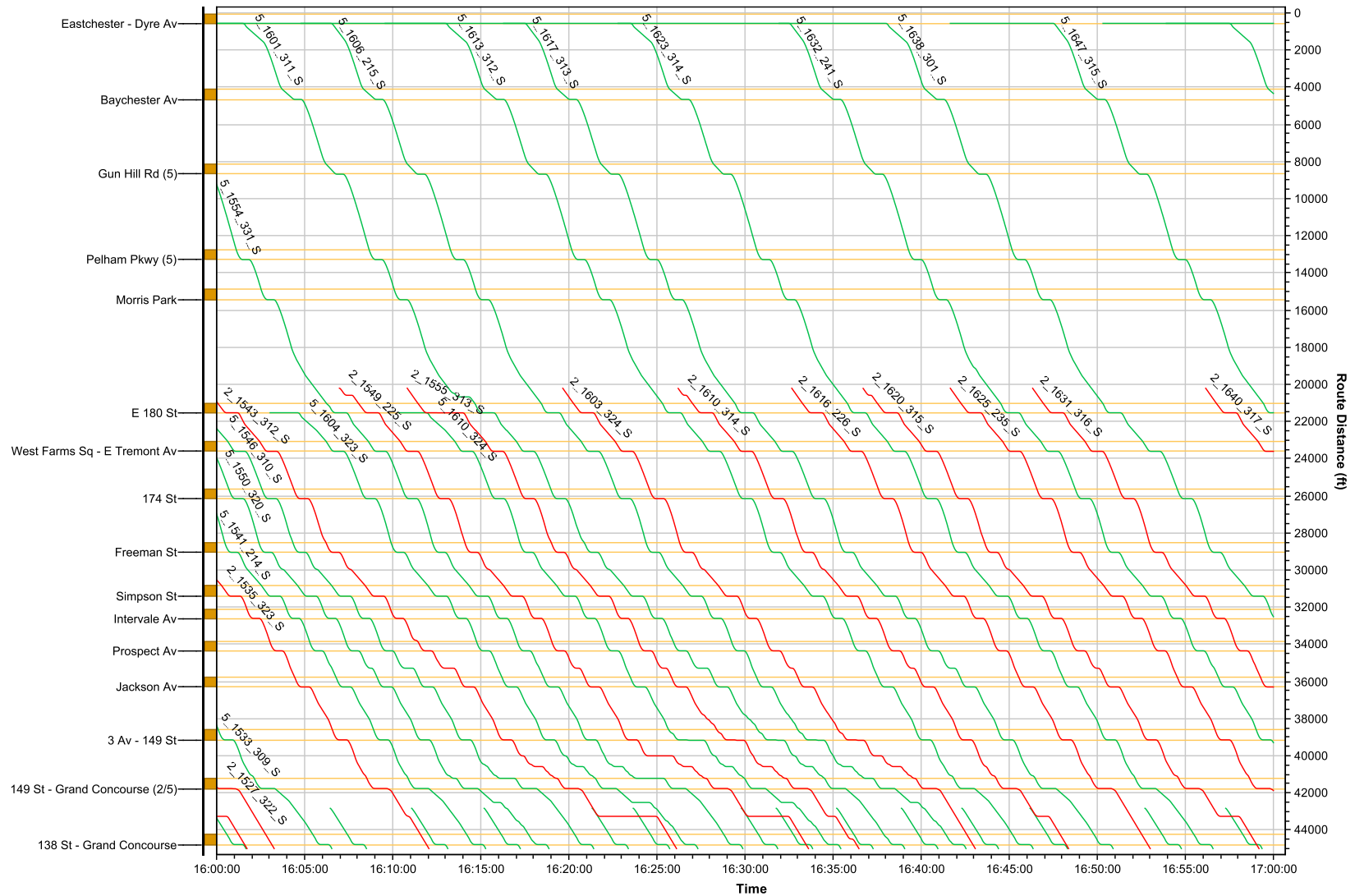
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Figure F.3-109: String Chart – Eastchester-Dyre Avenue to 138 Street-Grand Concourse – Southbound – 3:00 to 4:00 p.m.



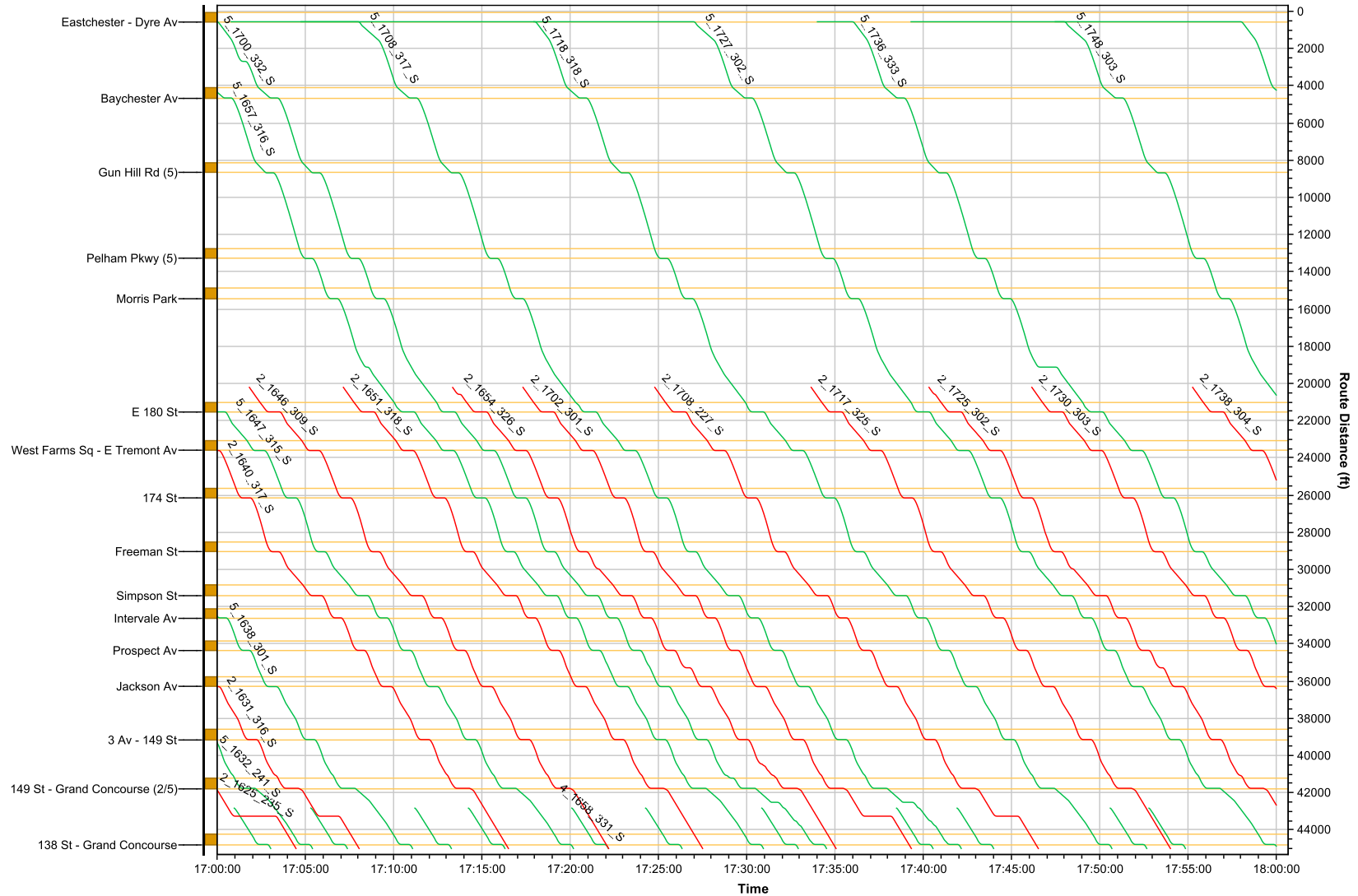
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Figure F.3-110: String Chart – Eastchester-Dyre Avenue to 138 Street-Grand Concourse – Southbound – 4:00 to 5:00 p.m.



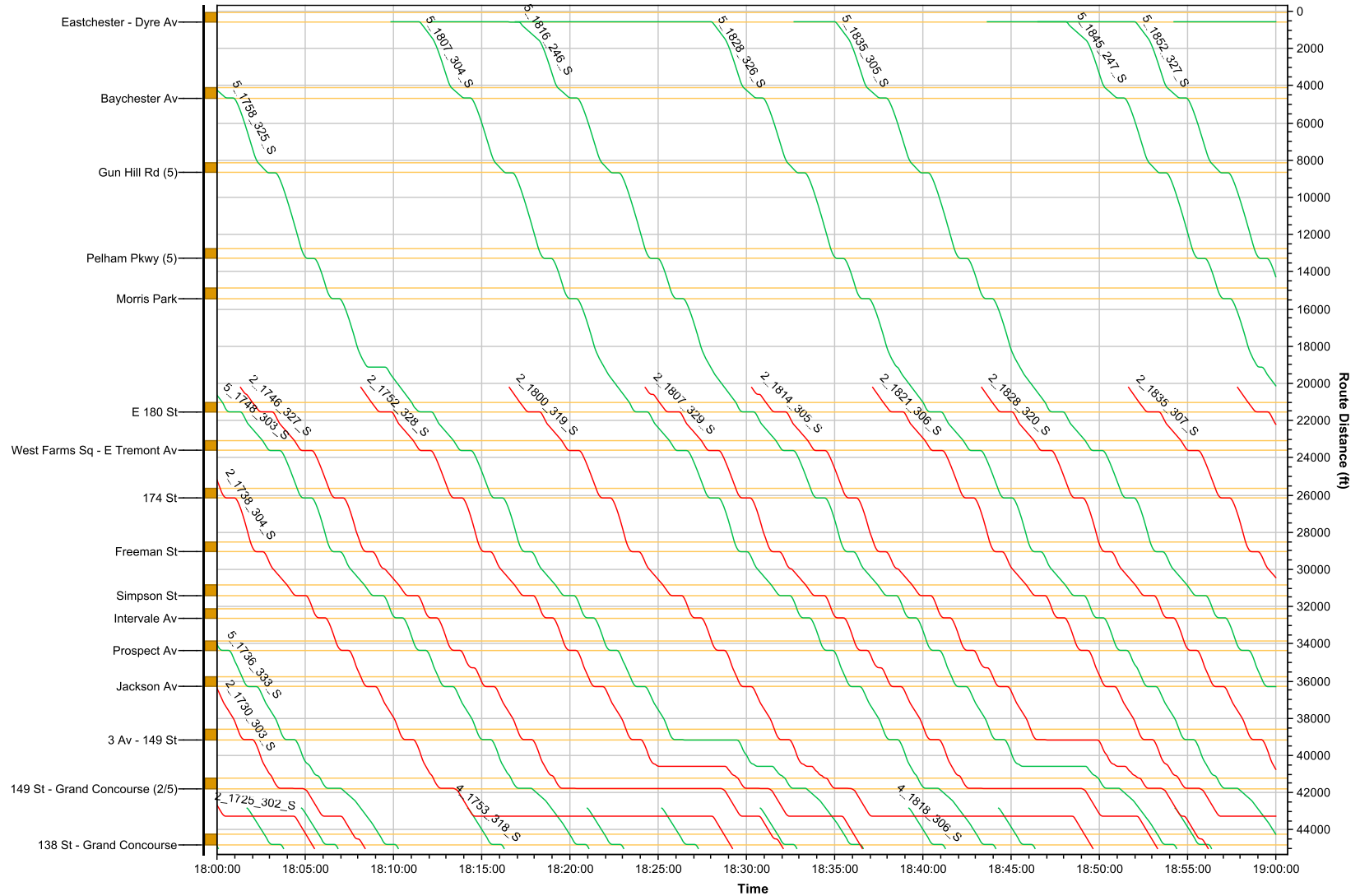
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Figure F.3-111: String Chart – Eastchester-Dyre Avenue to 138 Street-Grand Concourse – Southbound – 5:00 to 6:00 p.m.



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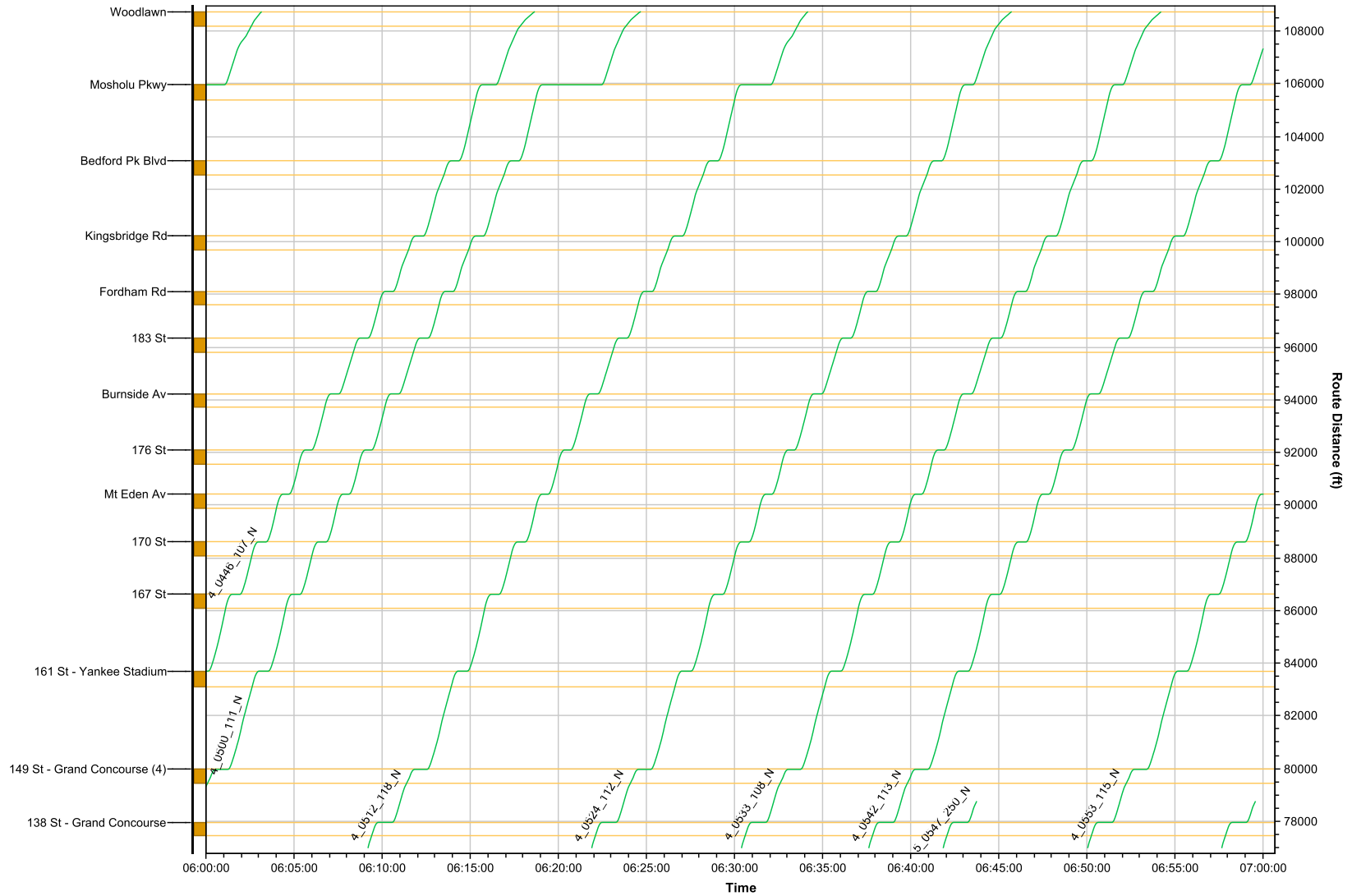
Figure F.3-112: String Chart – Eastchester-Dyre Avenue to 138 Street-Grand Concourse – Southbound – 6:00 to 7:00 p.m.



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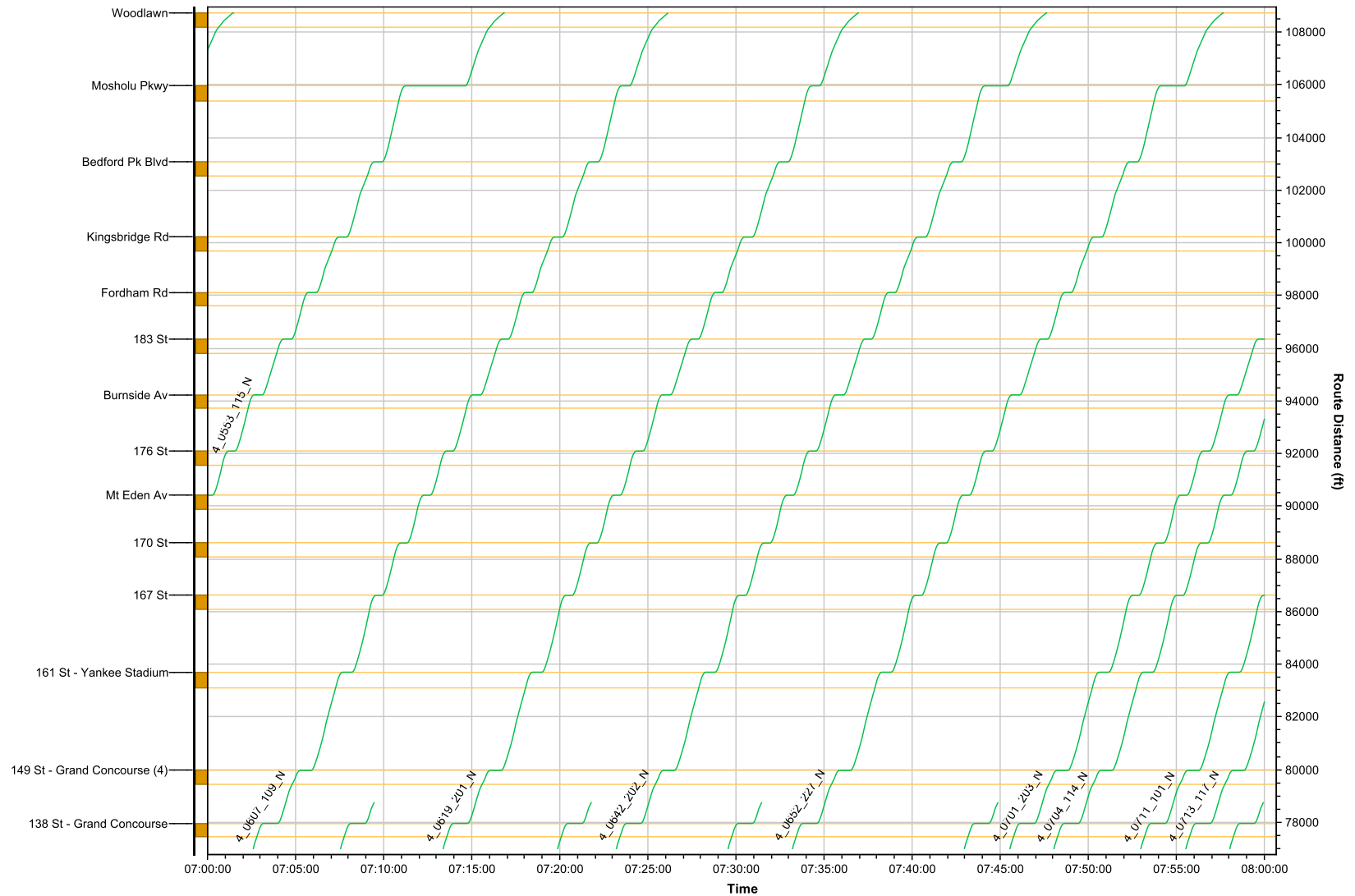
F.3.8 Woodlawn to 138 Street-Grand Concourse

Figure F.3-113: String Chart – 138 Street-Grand Concourse to Woodlawn – Northbound – 6:00 to 7:00 a.m.



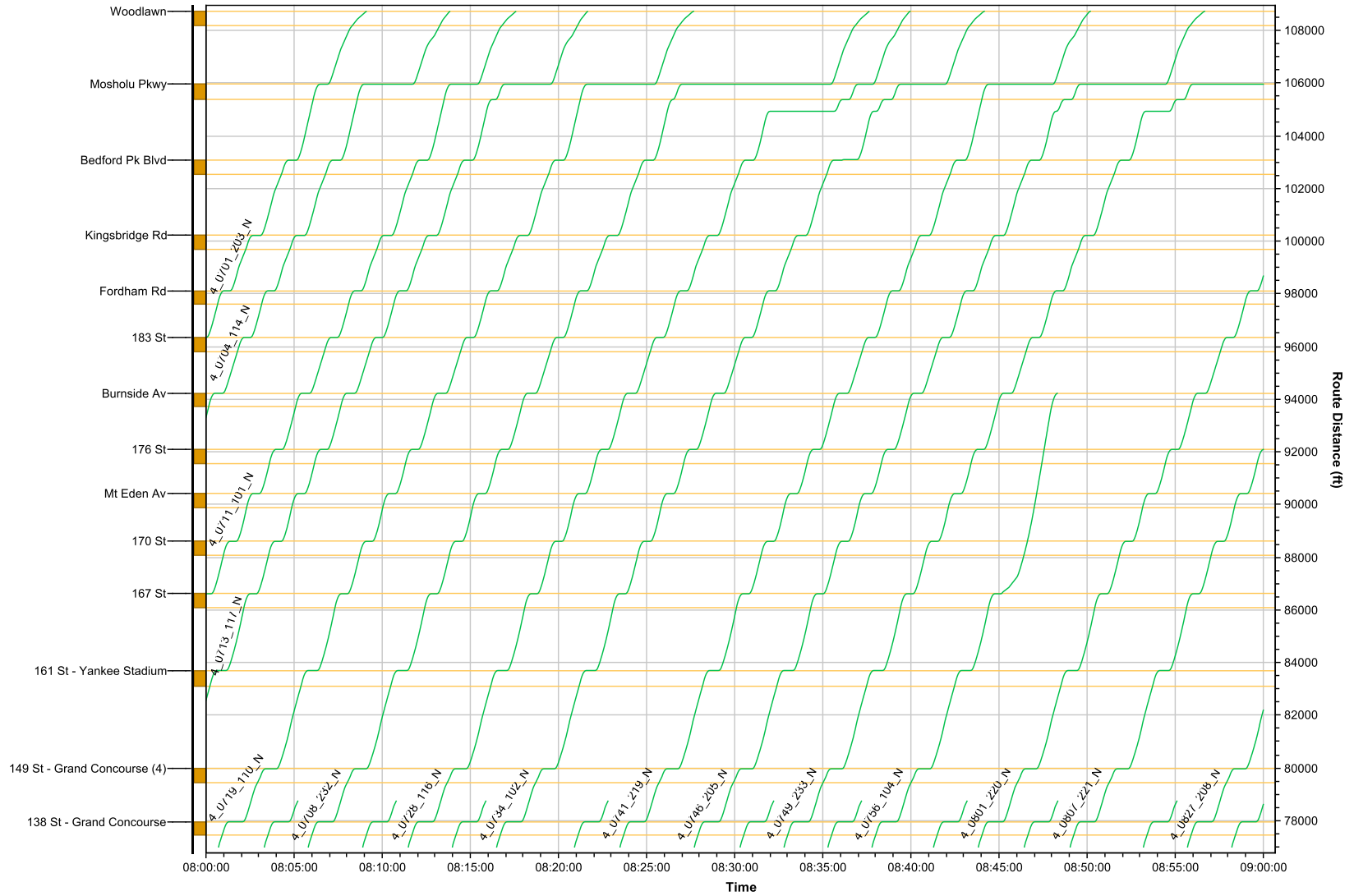
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Figure F.3-114: String Chart – 138 Street -Grand Concourse to Woodlawn – Northbound – 7:00 to 8:00 a.m.



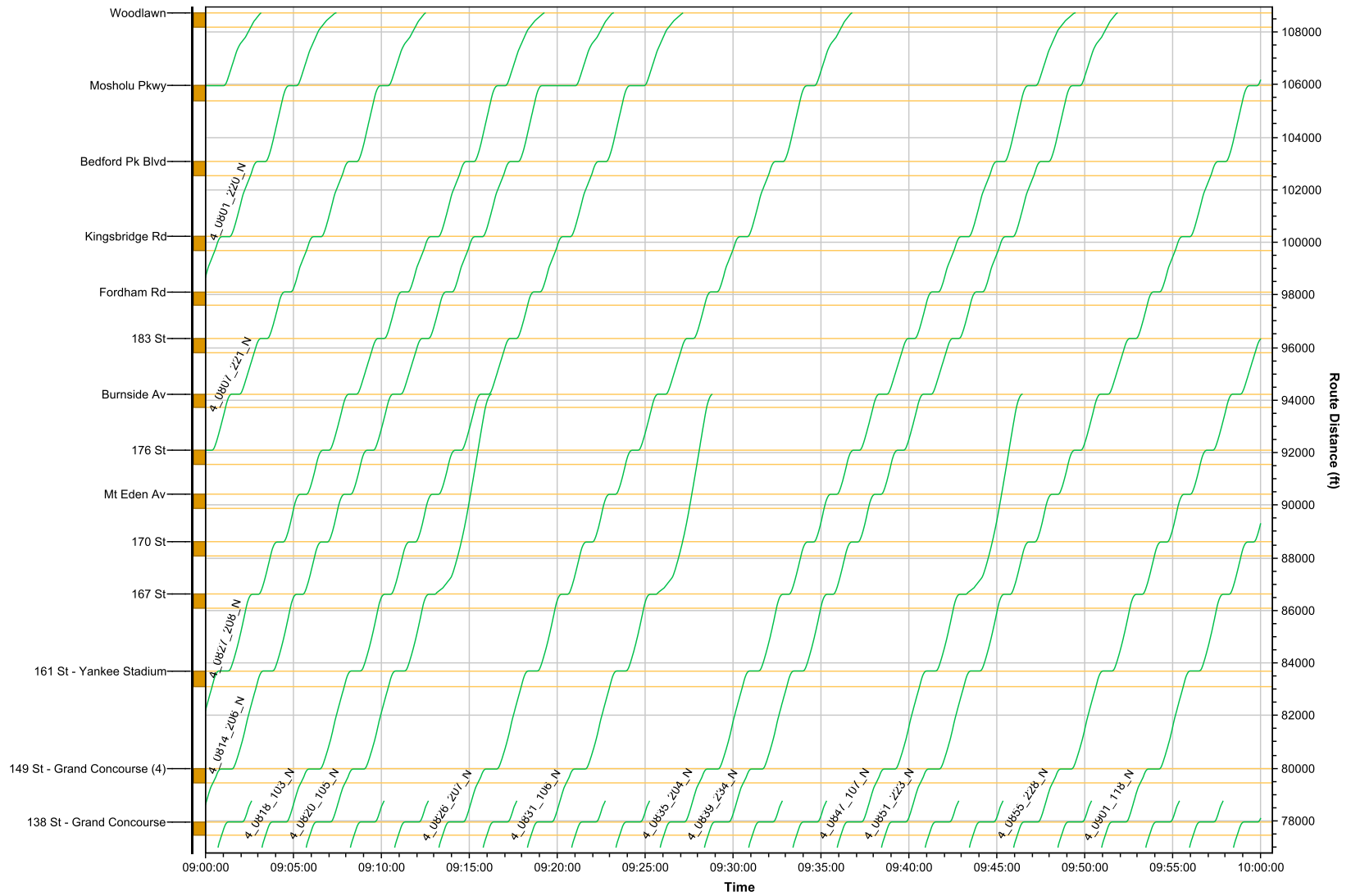
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Figure F.3-115: String Chart – 138 Street -Grand Concourse to Woodlawn – Northbound – 8:00 to 9:00 a.m.



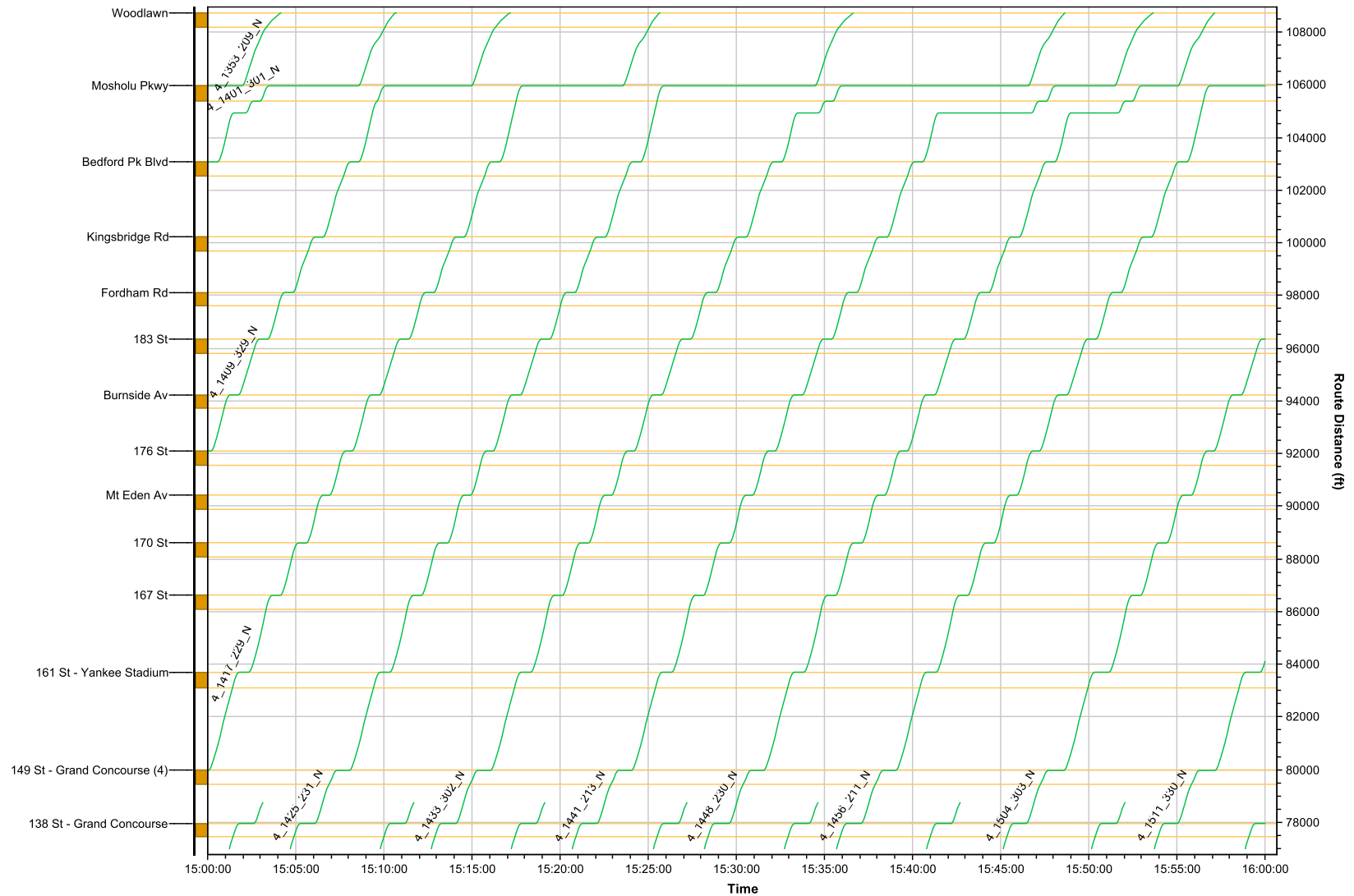
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Figure F.3-116: String Chart – 138 Street -Grand Concourse to Woodlawn – Northbound – 9:00 to 10:00 a.m.



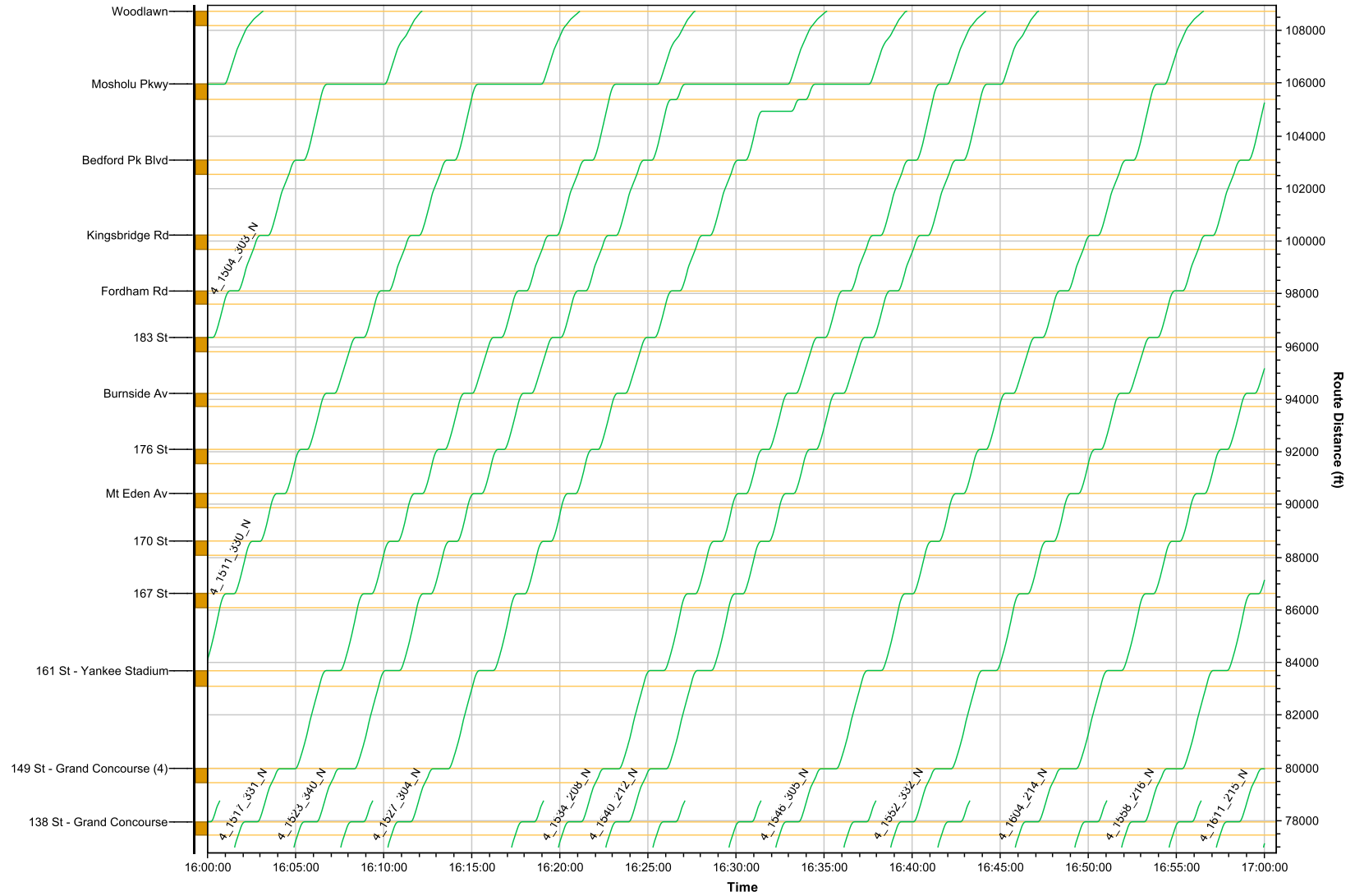
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Figure F.3-117: String Chart – 138 Street -Grand Concourse to Woodlawn – Northbound – 3:00 to 4:00 p.m.



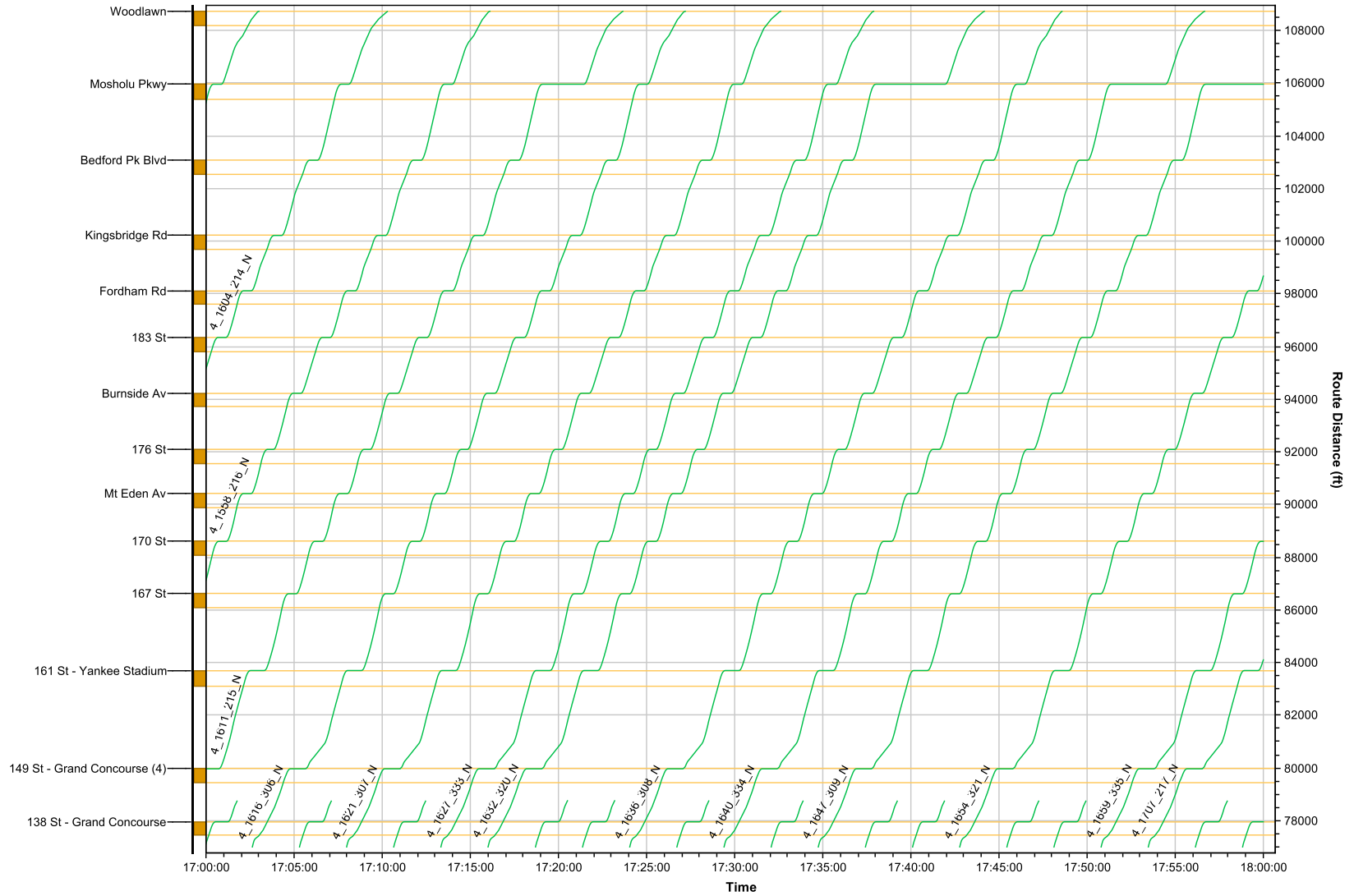
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Figure F.3-118: String Chart – 138 Street -Grand Concourse to Woodlawn – Northbound – 4:00 to 5:00 p.m.



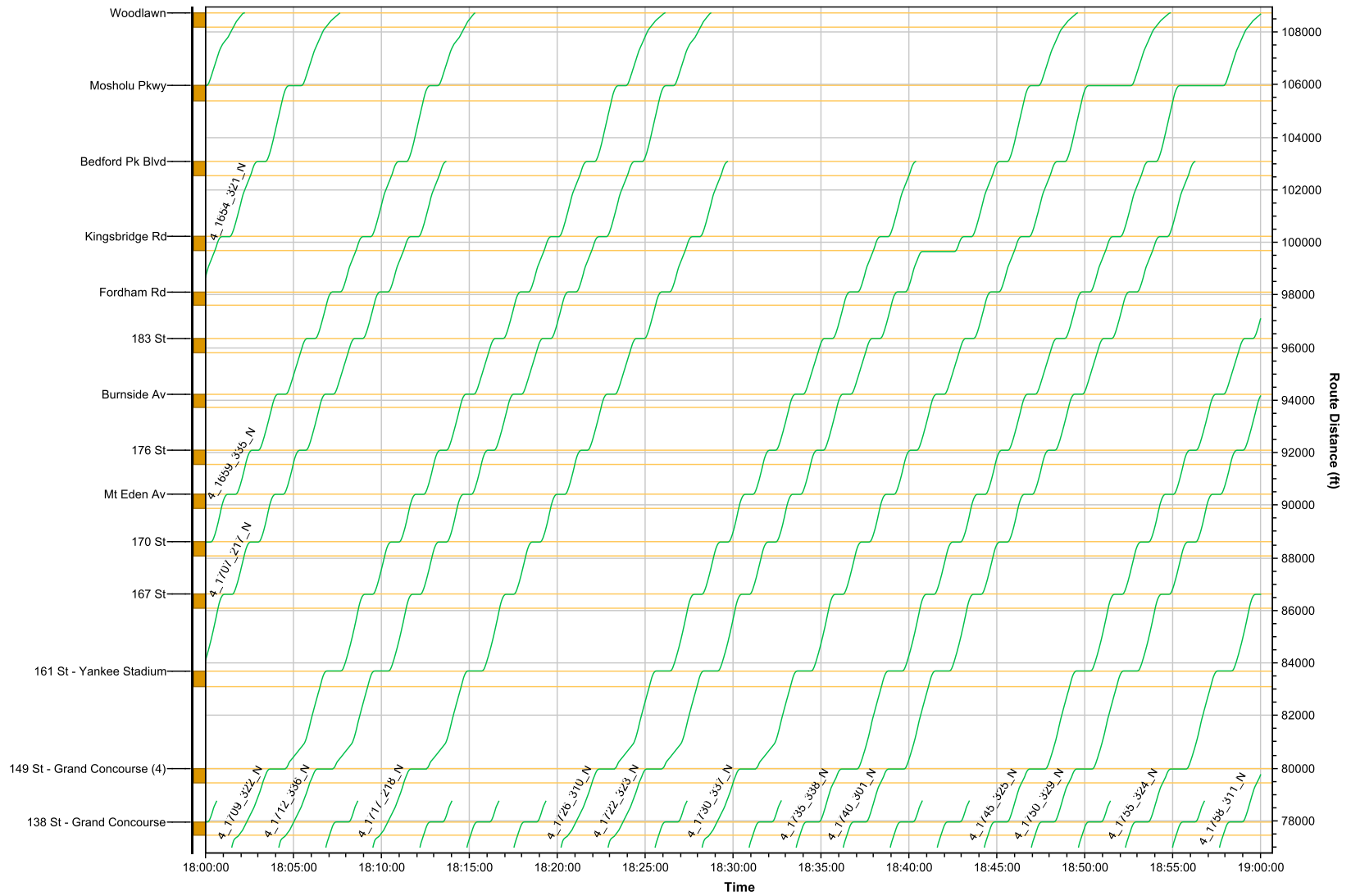
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Figure F.3-119: String Chart – 138 Street -Grand Concourse to Woodlawn – Northbound – 5:00 to 6:00 p.m.



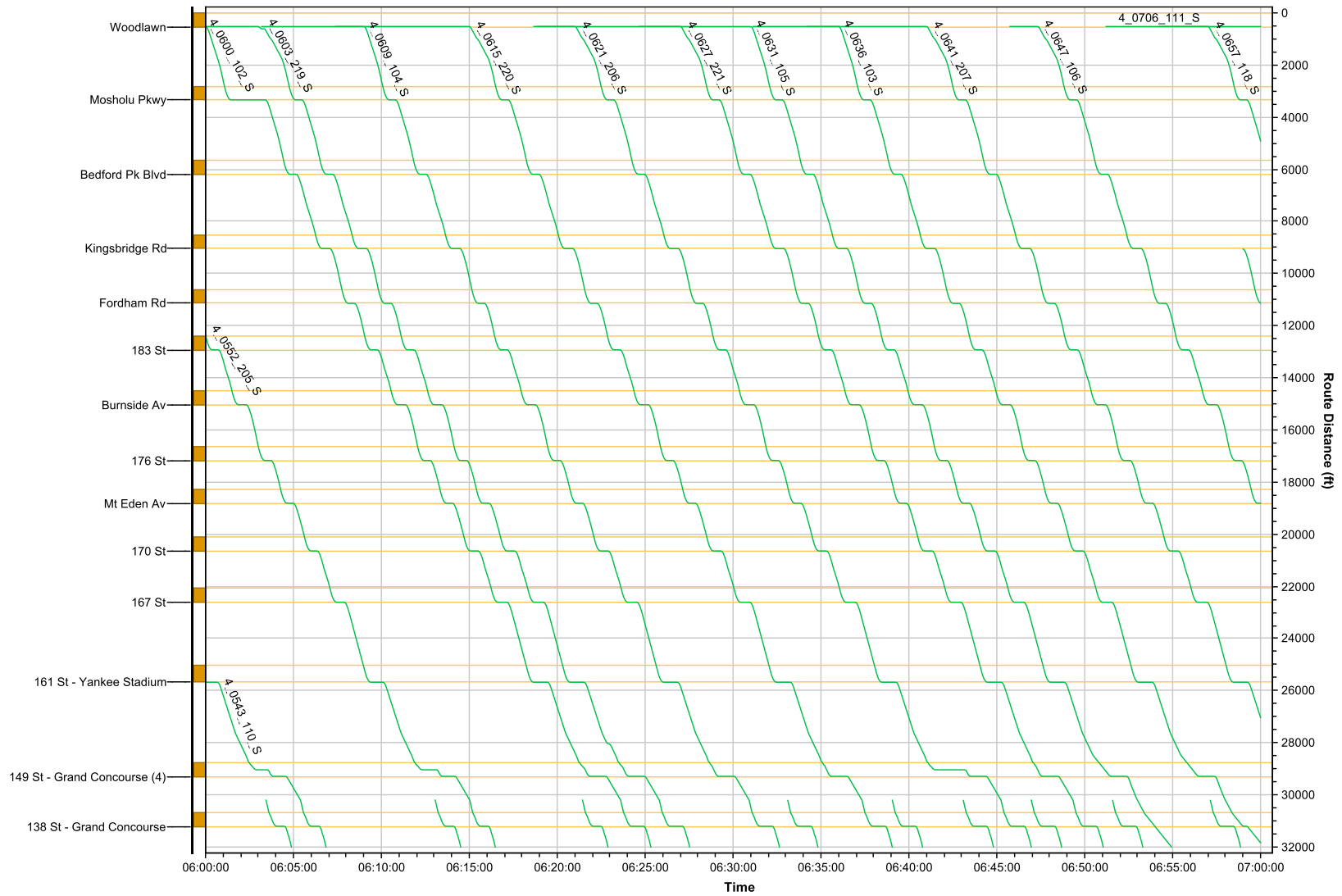
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-120: String Chart – 138 Street -Grand Concourse to Woodlawn – Northbound – 6:00 to 7:00 p.m.



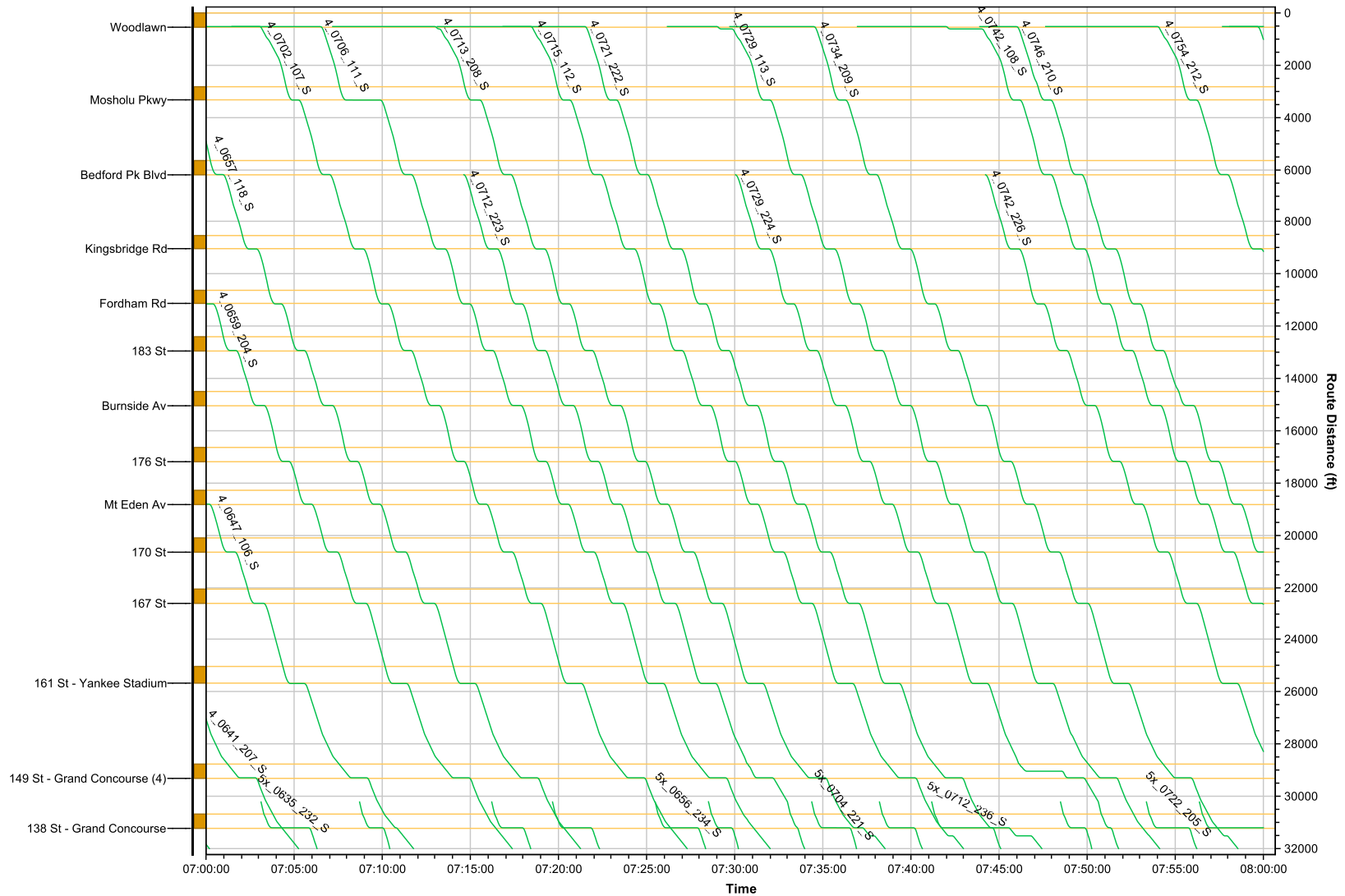
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-121: String Chart – Woodlawn to 138 Street -Grand Concourse – Southbound – 6:00 to 7:00 a.m.



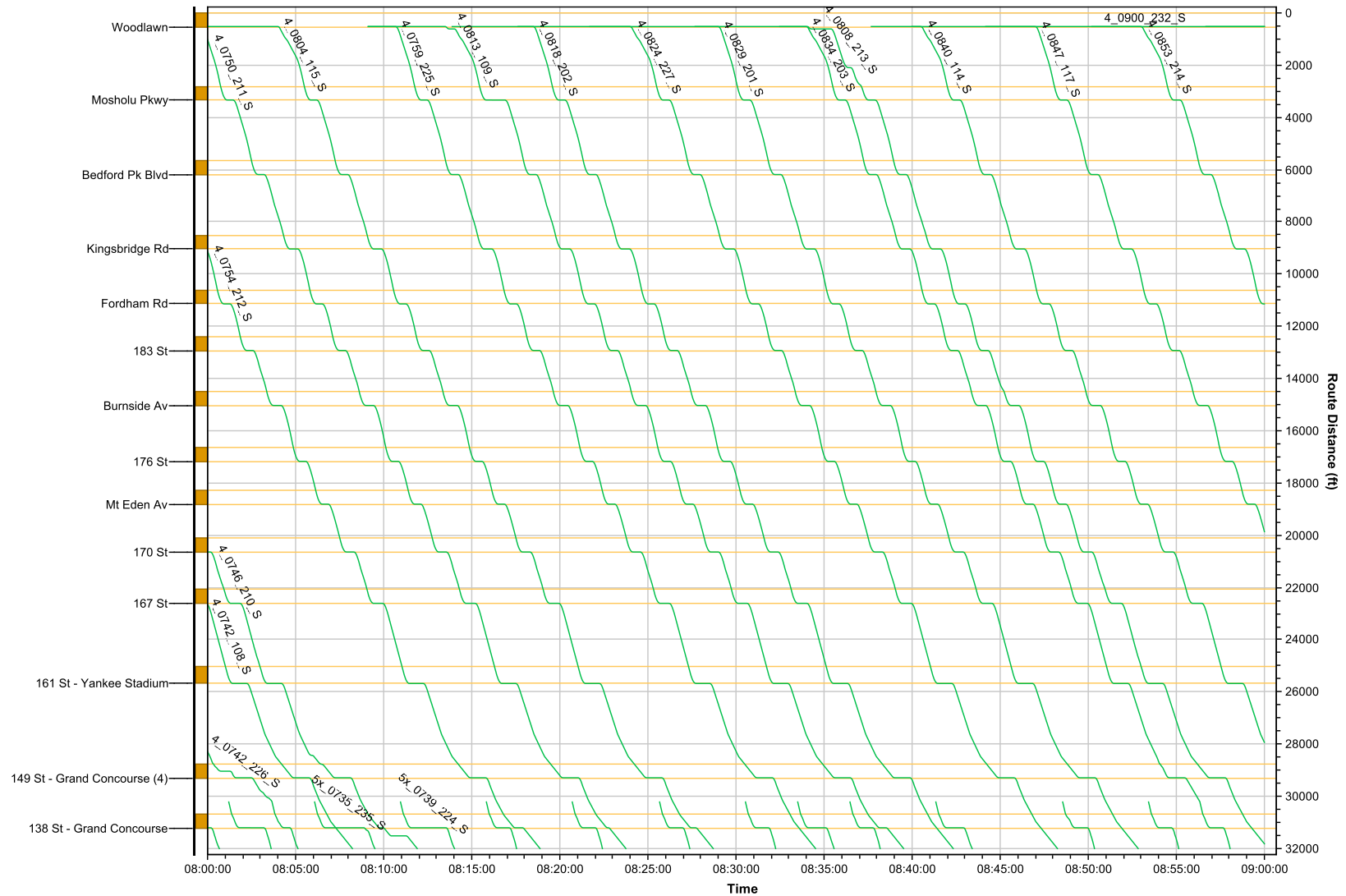
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-122: String Chart – Woodlawn to 138 Street -Grand Concourse – Southbound – 7:00 to 8:00 a.m.



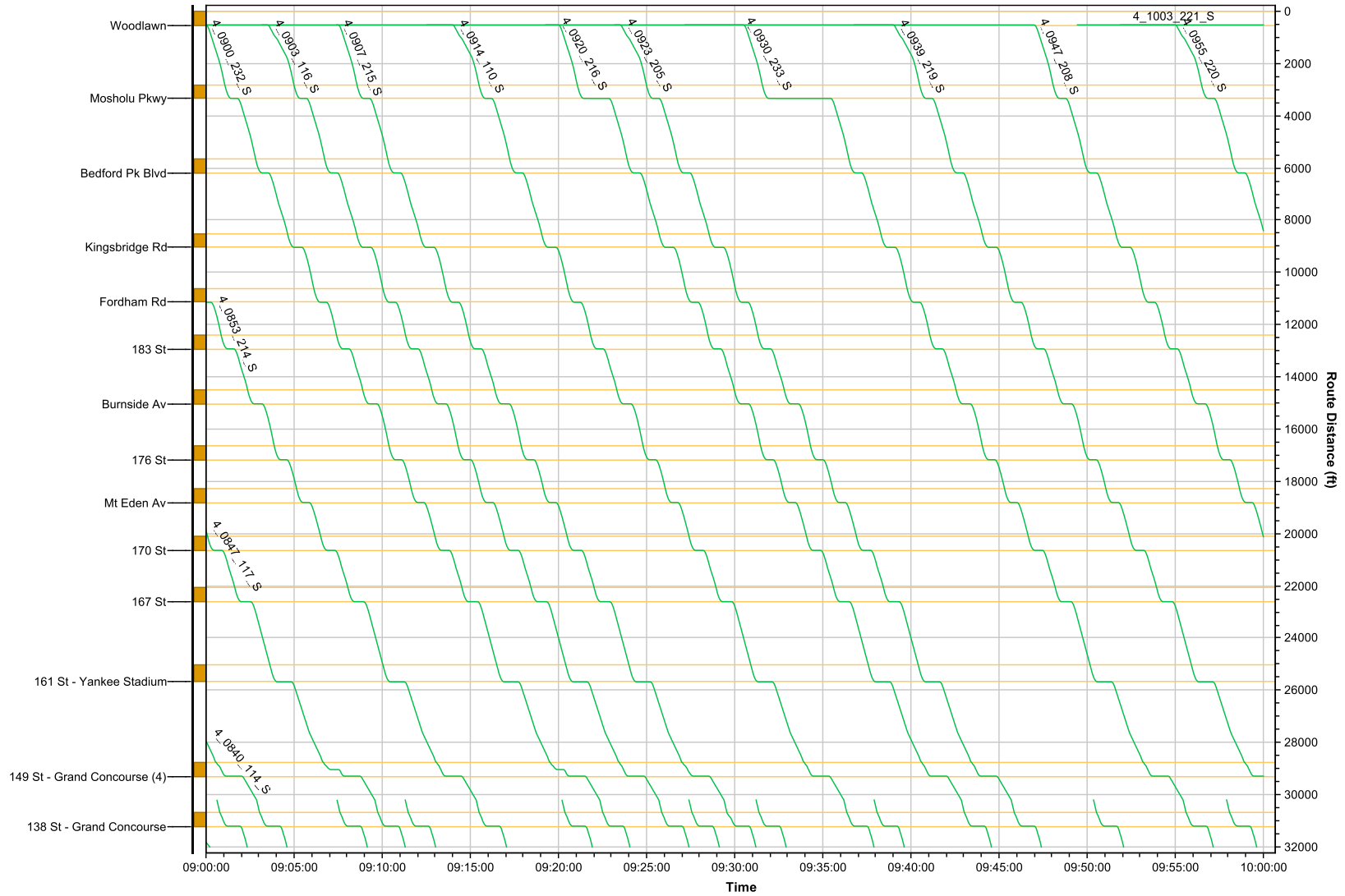
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Figure F.3-123: String Chart – Woodlawn to 138 Street -Grand Concourse – Southbound – 8:00 to 9:00 a.m.



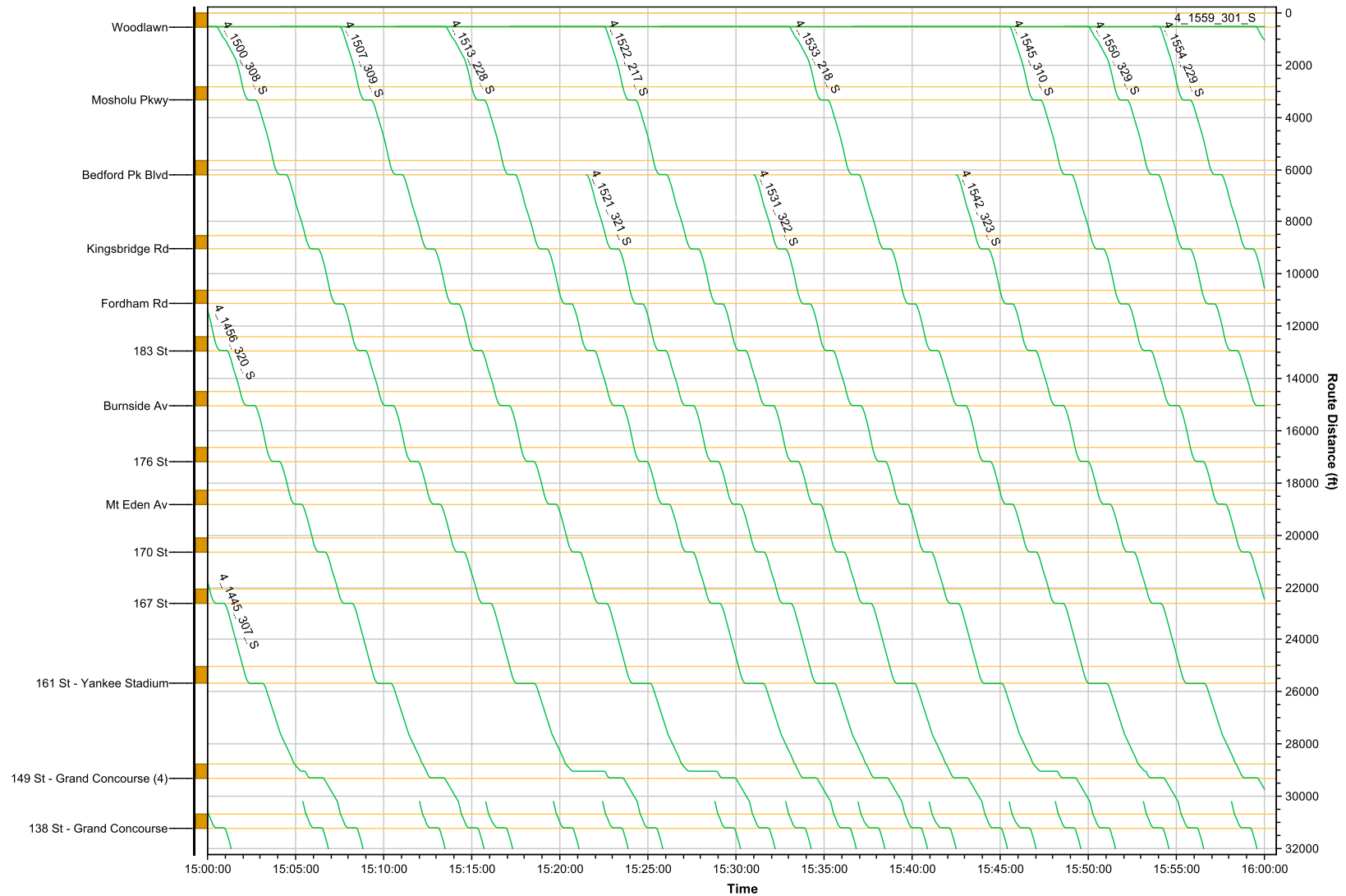
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-124: String Chart – Woodlawn to 138 Street -Grand Concourse – Southbound – 9:00 to 10:00 a.m.



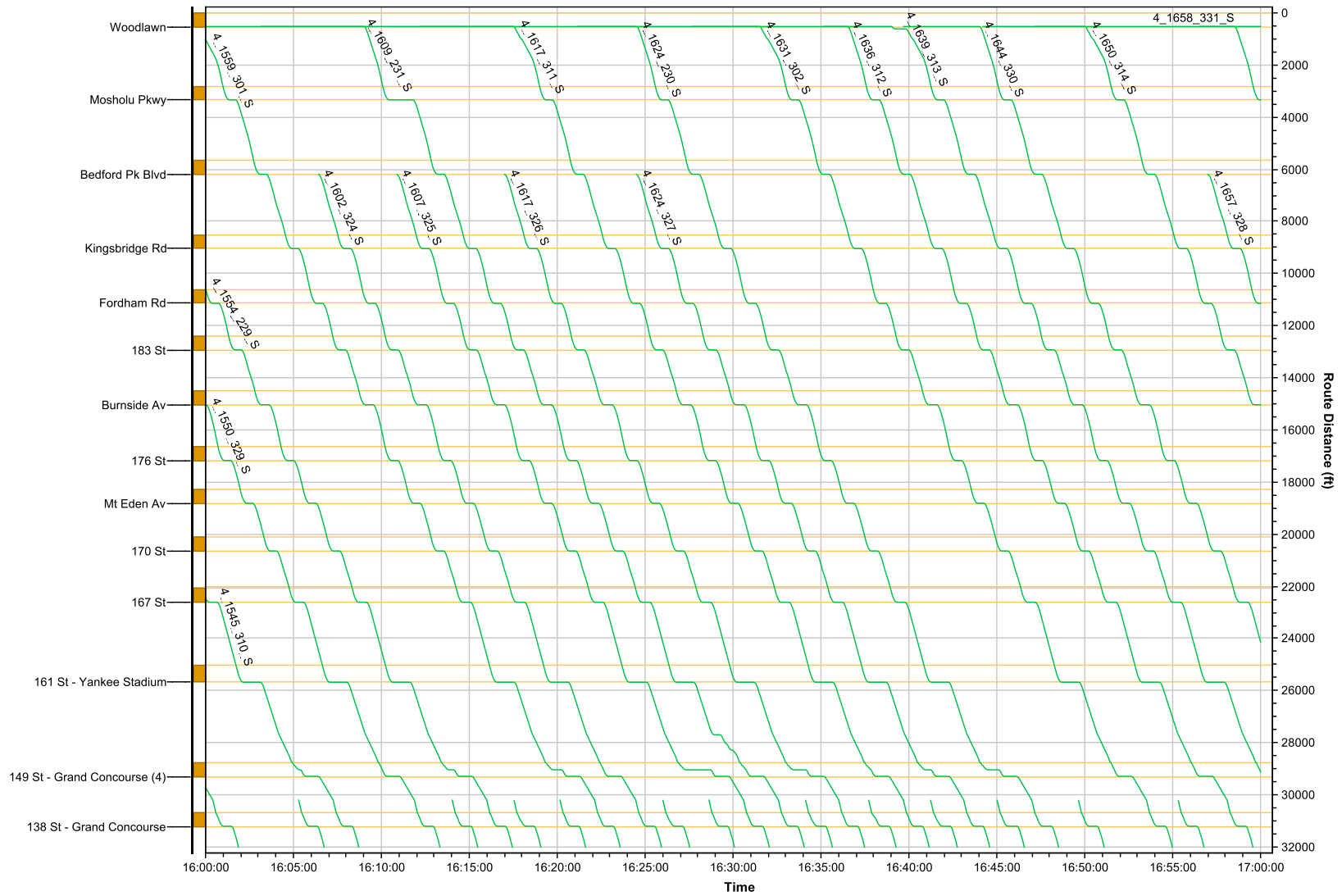
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Figure F.3-125: String Chart – Woodlawn to 138 Street -Grand Concourse – Southbound – 3:00 to 4:00 p.m.



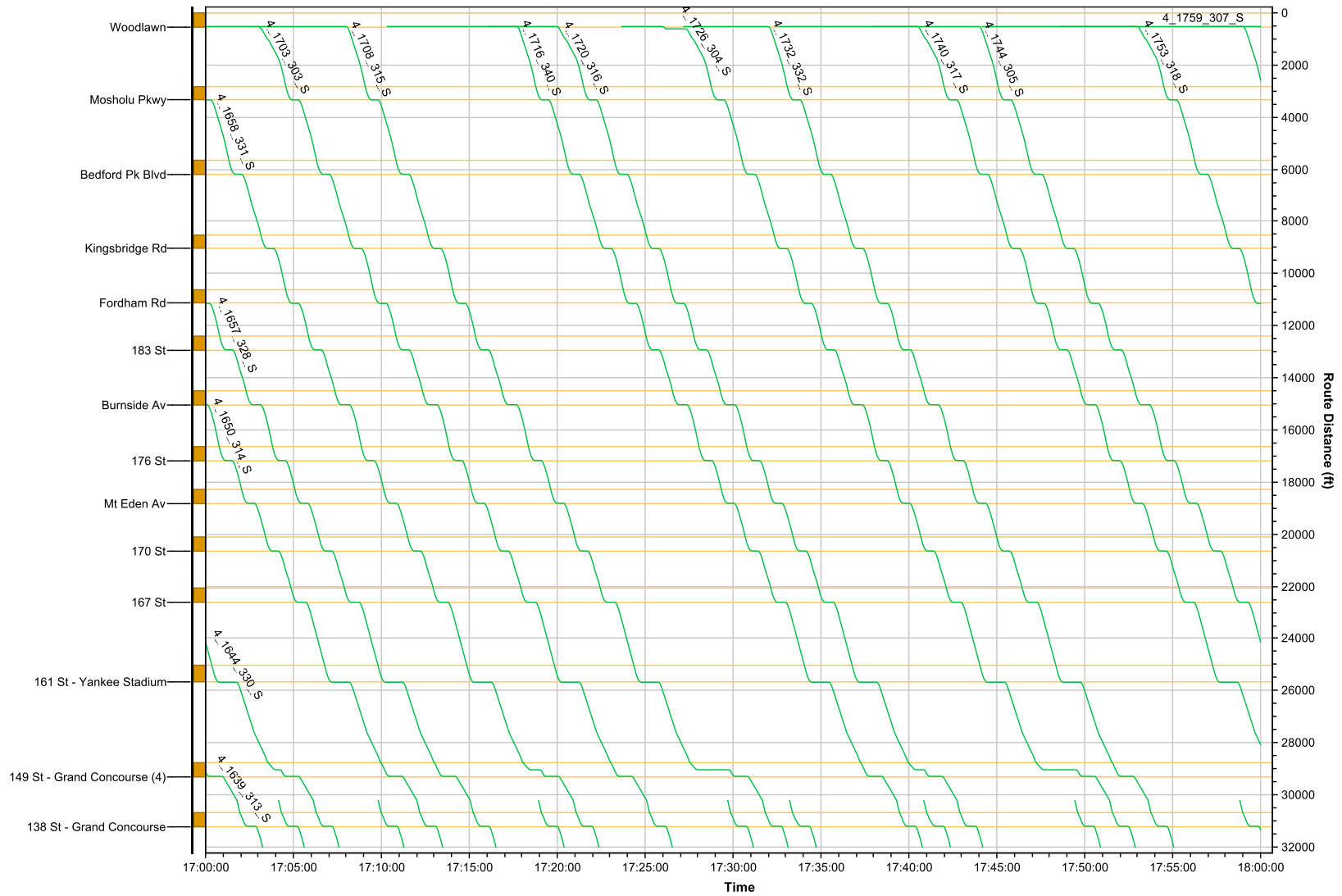
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-126: String Chart – Woodlawn to 138 Street -Grand Concourse – Southbound – 4:00 to 5:00 p.m.



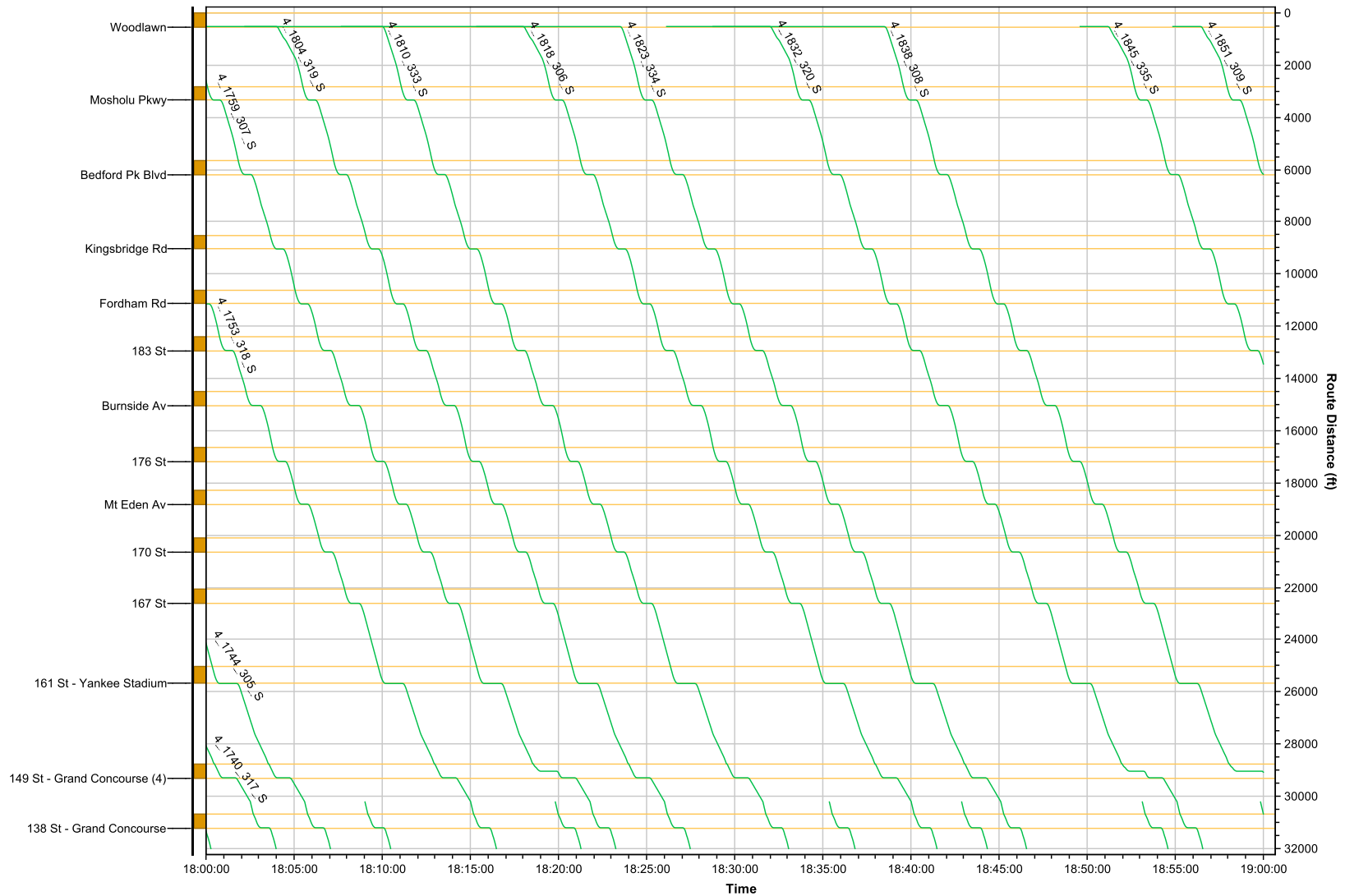
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Figure F.3-127: String Chart – Woodlawn to 138 Street -Grand Concourse – Southbound – 5:00 to 6:00 p.m.



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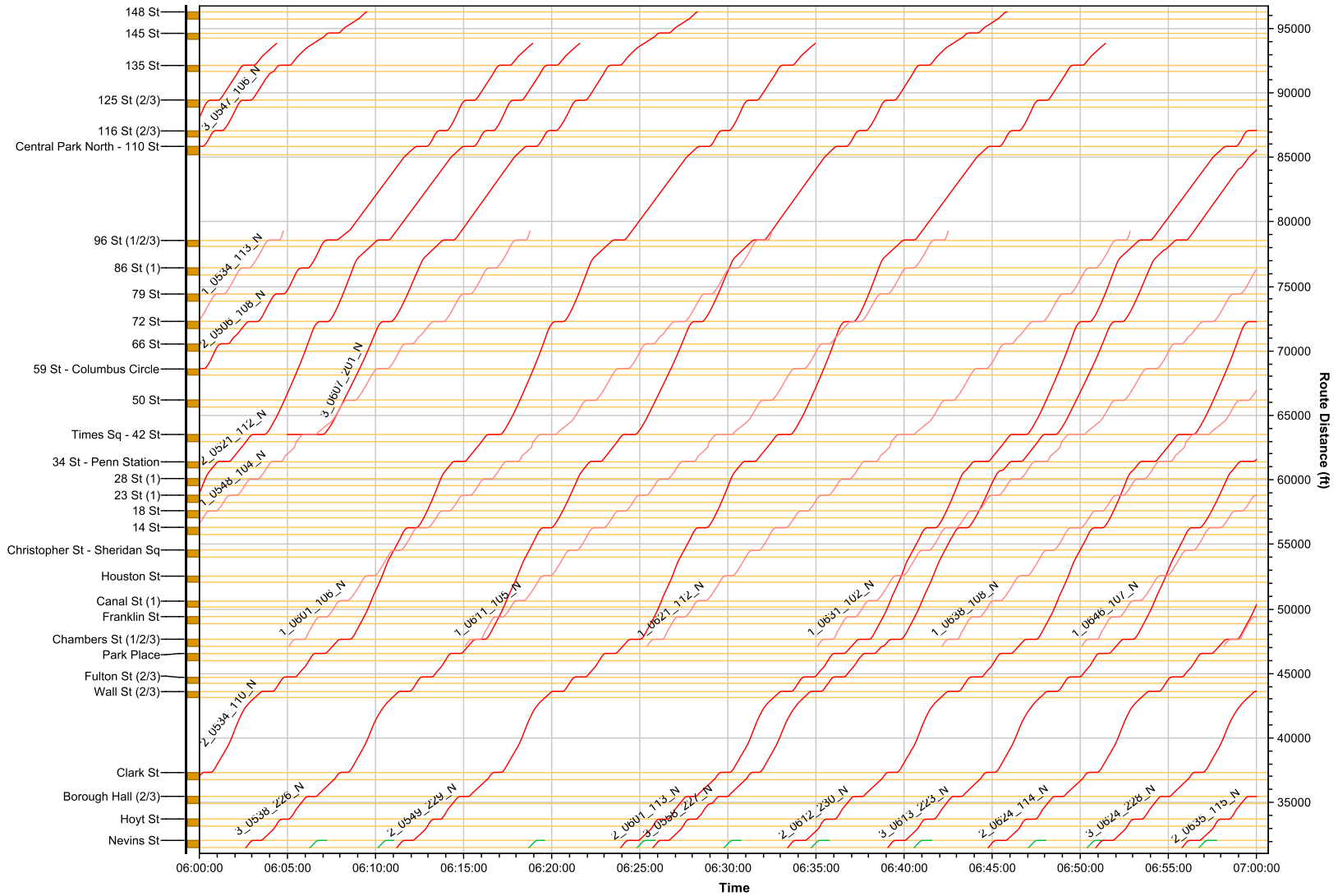
Figure F.3-128: String Chart – Woodlawn to 138 Street -Grand Concourse – Southbound – 6:00 to 7:00 p.m.



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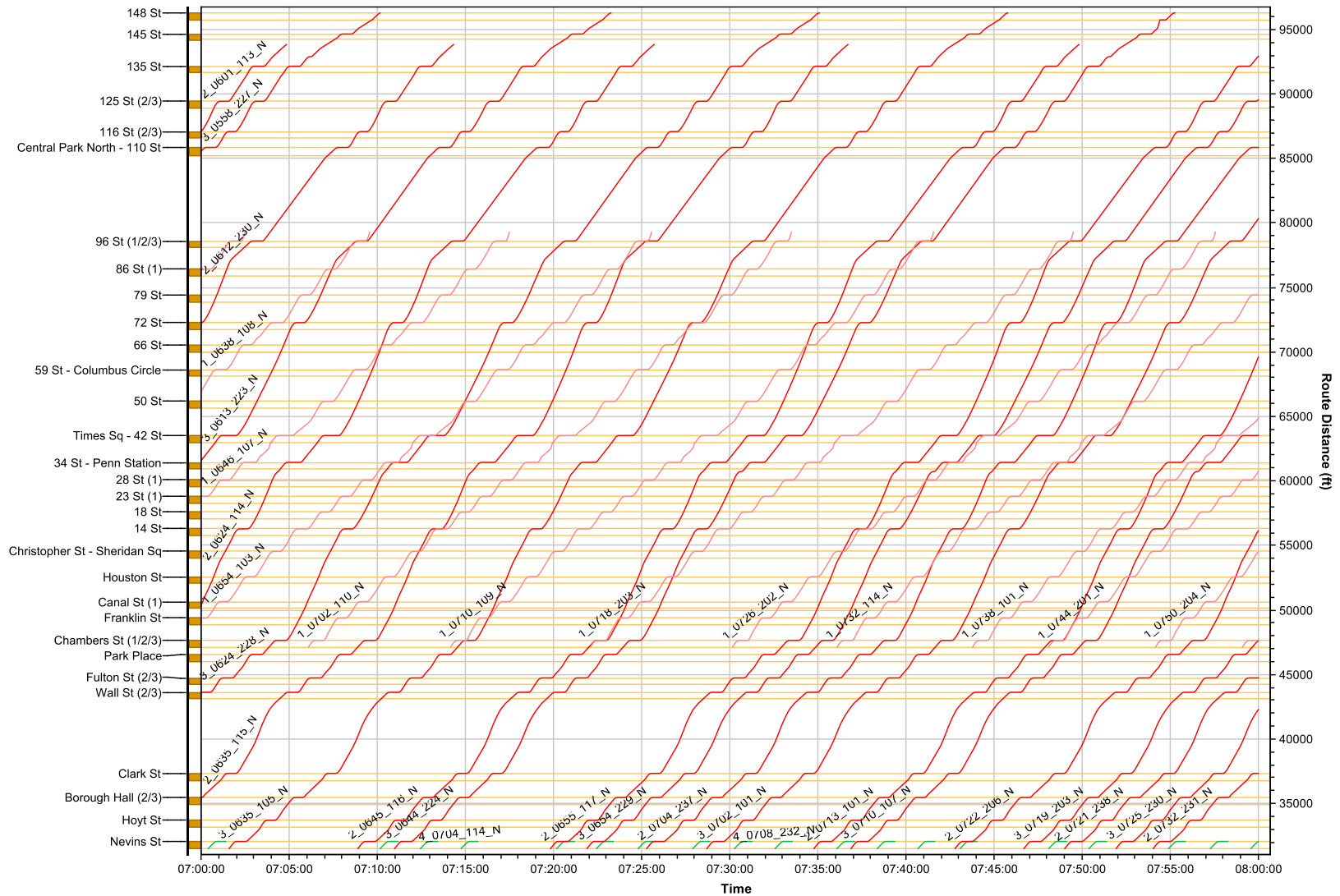
F.3.9 Harlem-148 Street to Nevins Street

Figure F.3-129: String Chart – Nevins Street to Harlem-148 Street – Northbound – 6:00 to 7:00 a.m.



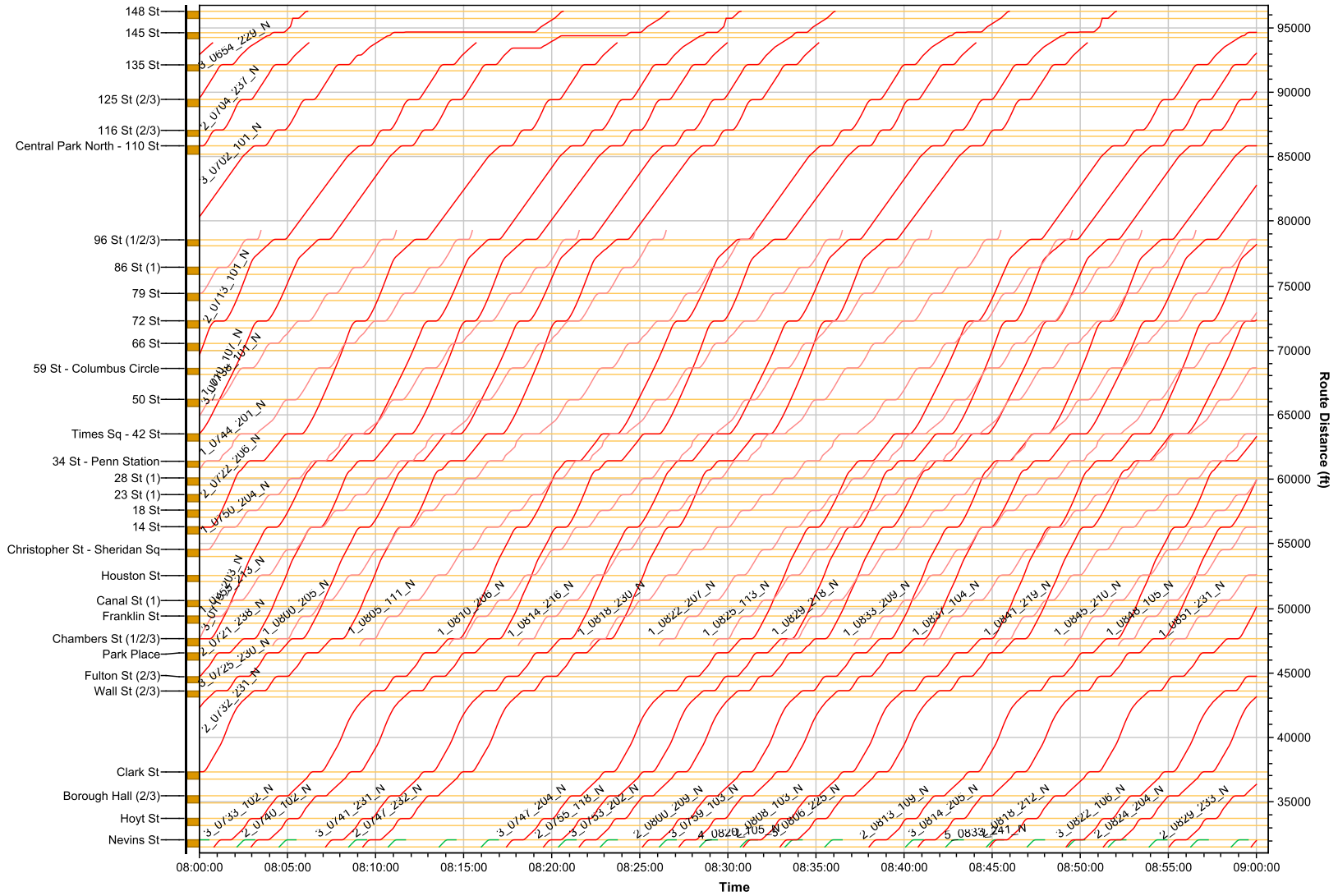
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Figure F.3-130: String Chart – Nevins Street to Harlem-148 Street – Northbound – 7:00 to 8:00 a.m.



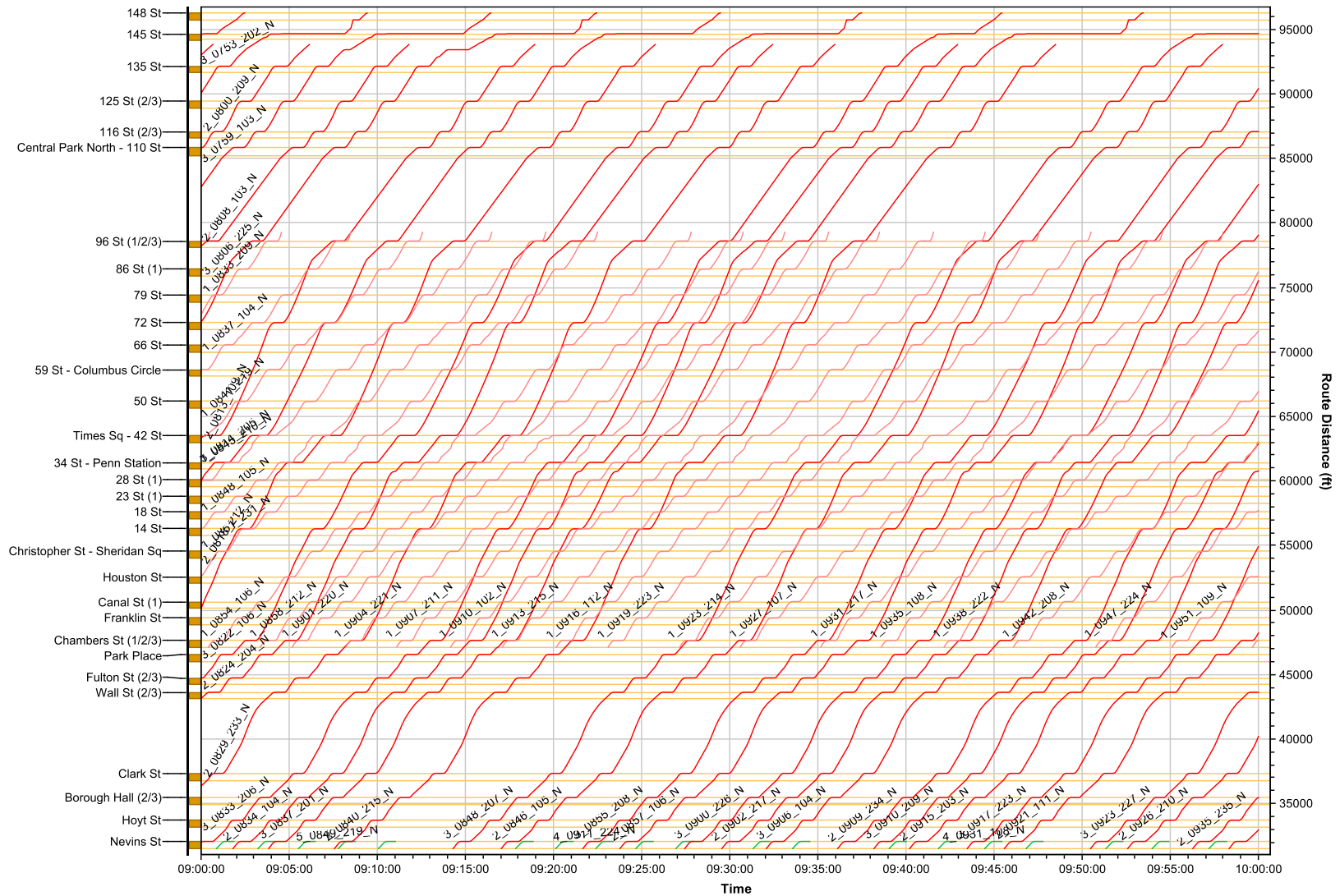
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Figure F.3-131: String Chart – Nevins Street to Harlem-148 Street – Northbound – 8:00 to 9:00 a.m.



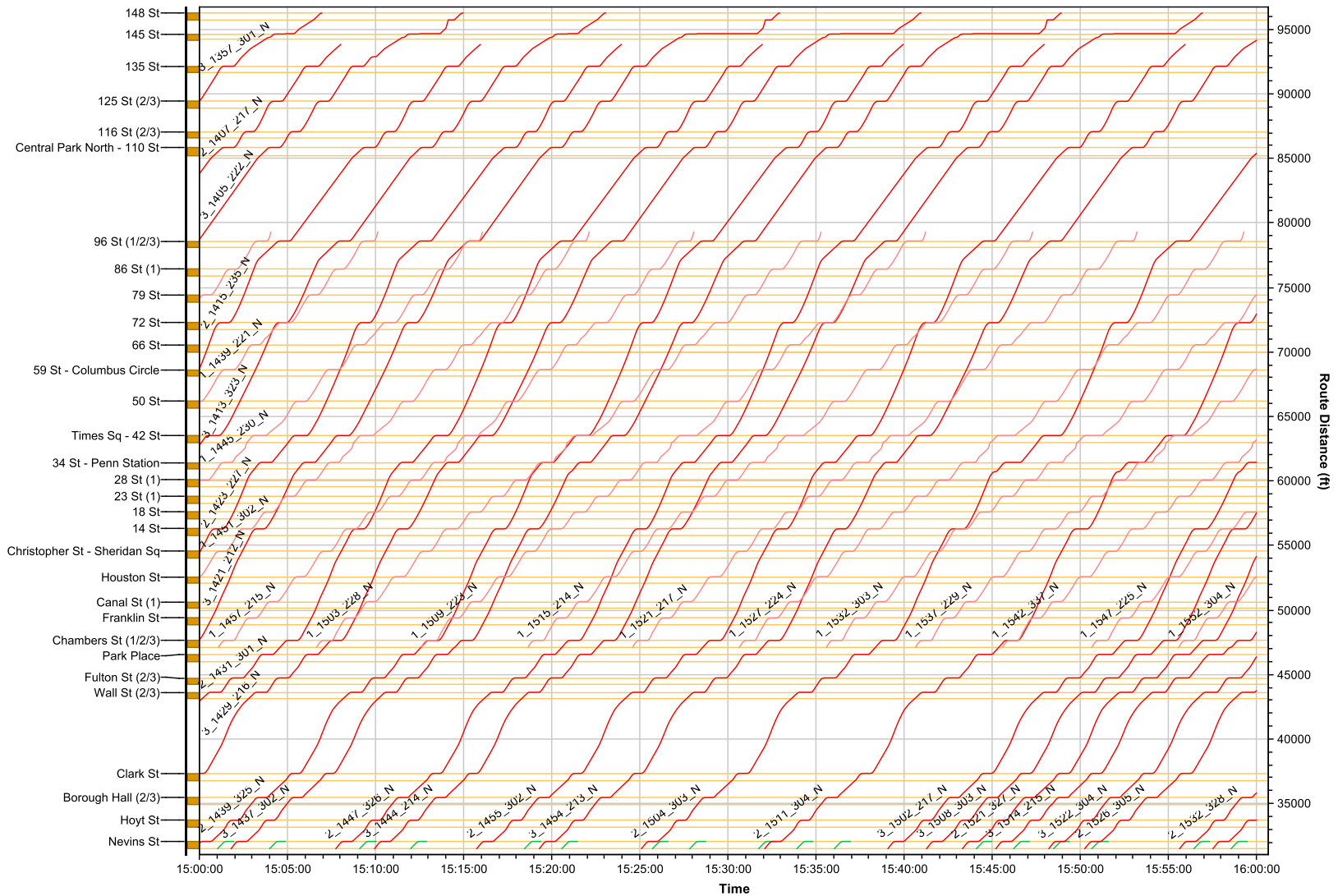
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Figure F.3-132: String Chart – Nevins Street to Harlem-148 Street – Northbound – 9:00 to 10:00 a.m.



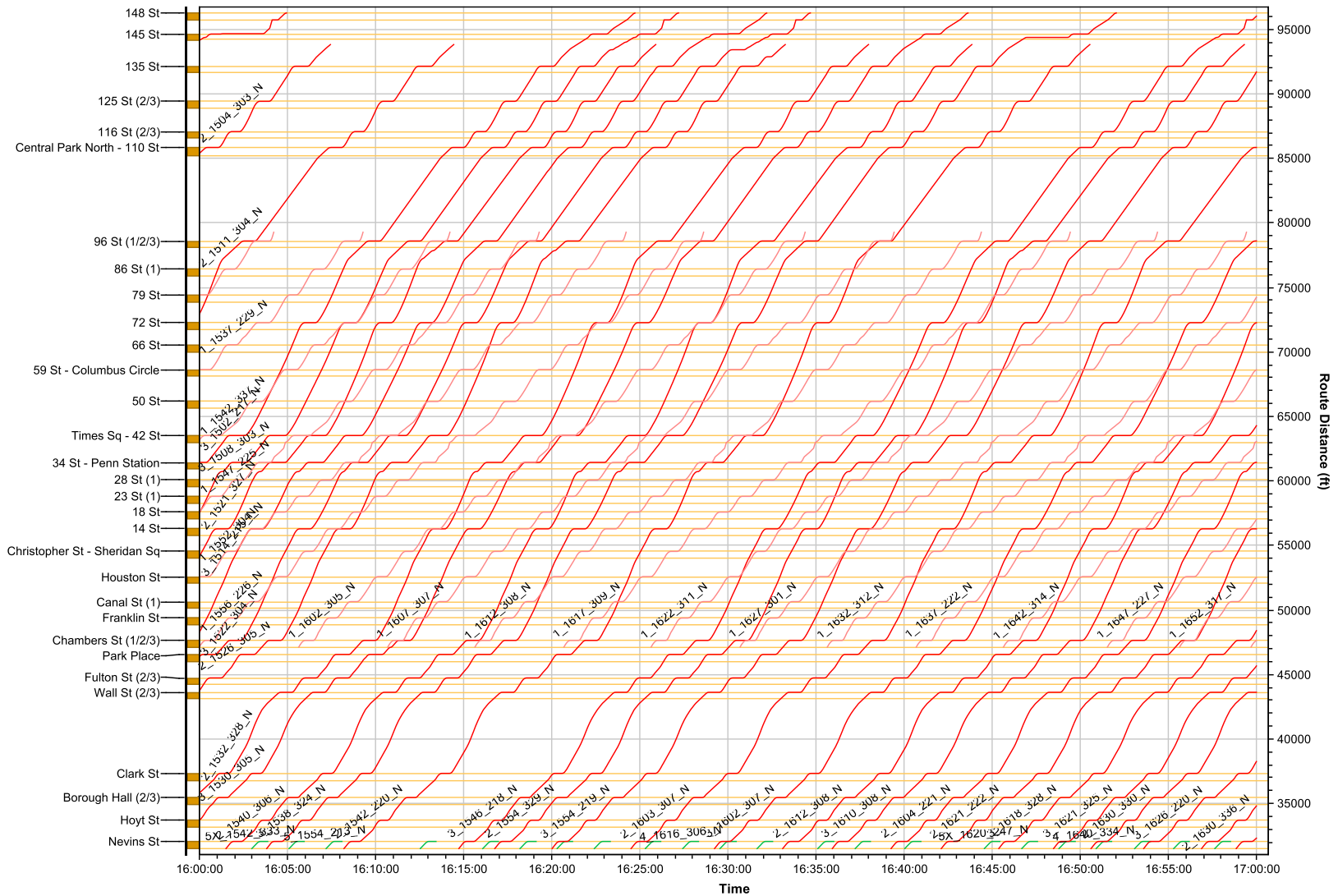
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Figure F.3-133: String Chart – Nevins Street to Harlem-148 Street – Northbound – 3:00 to 4:00 p.m.



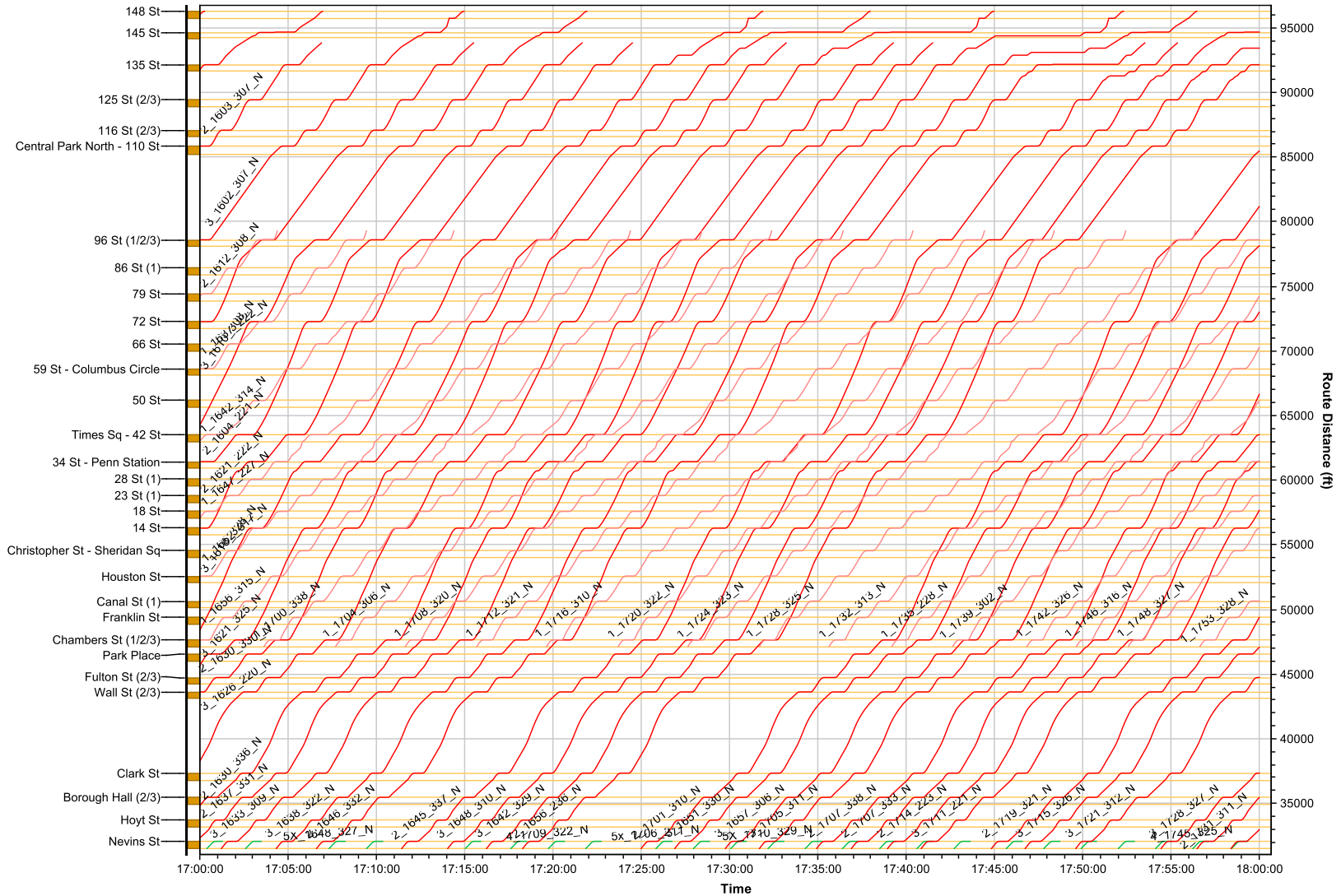
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Figure F.3-134: String Chart – Nevins Street to Harlem-148 Street – Northbound – 4:00 to 5:00 p.m.



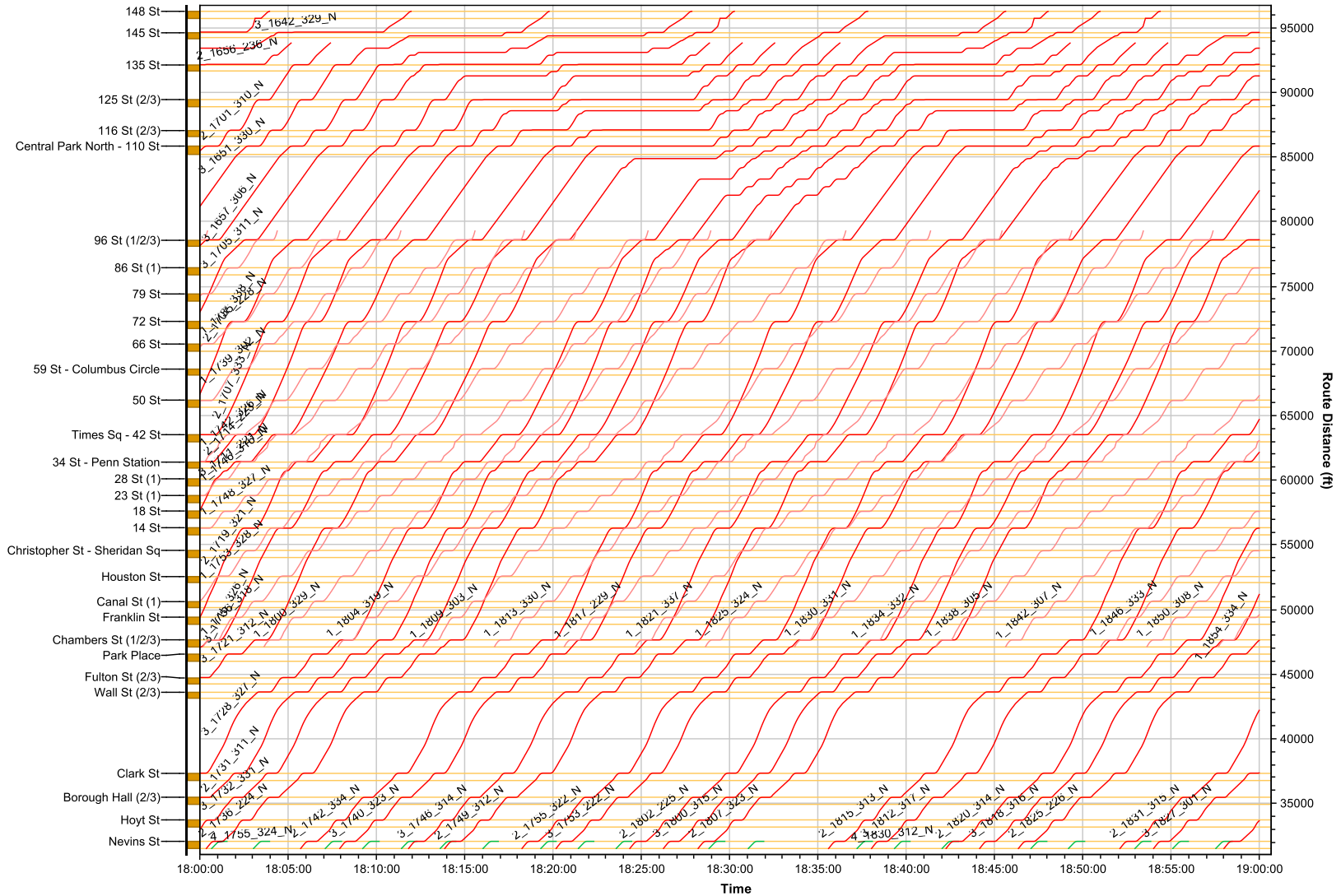
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Figure F.3-135: String Chart – Nevins Street to Harlem-148 Street – Northbound – 5:00 to 6:00 p.m.



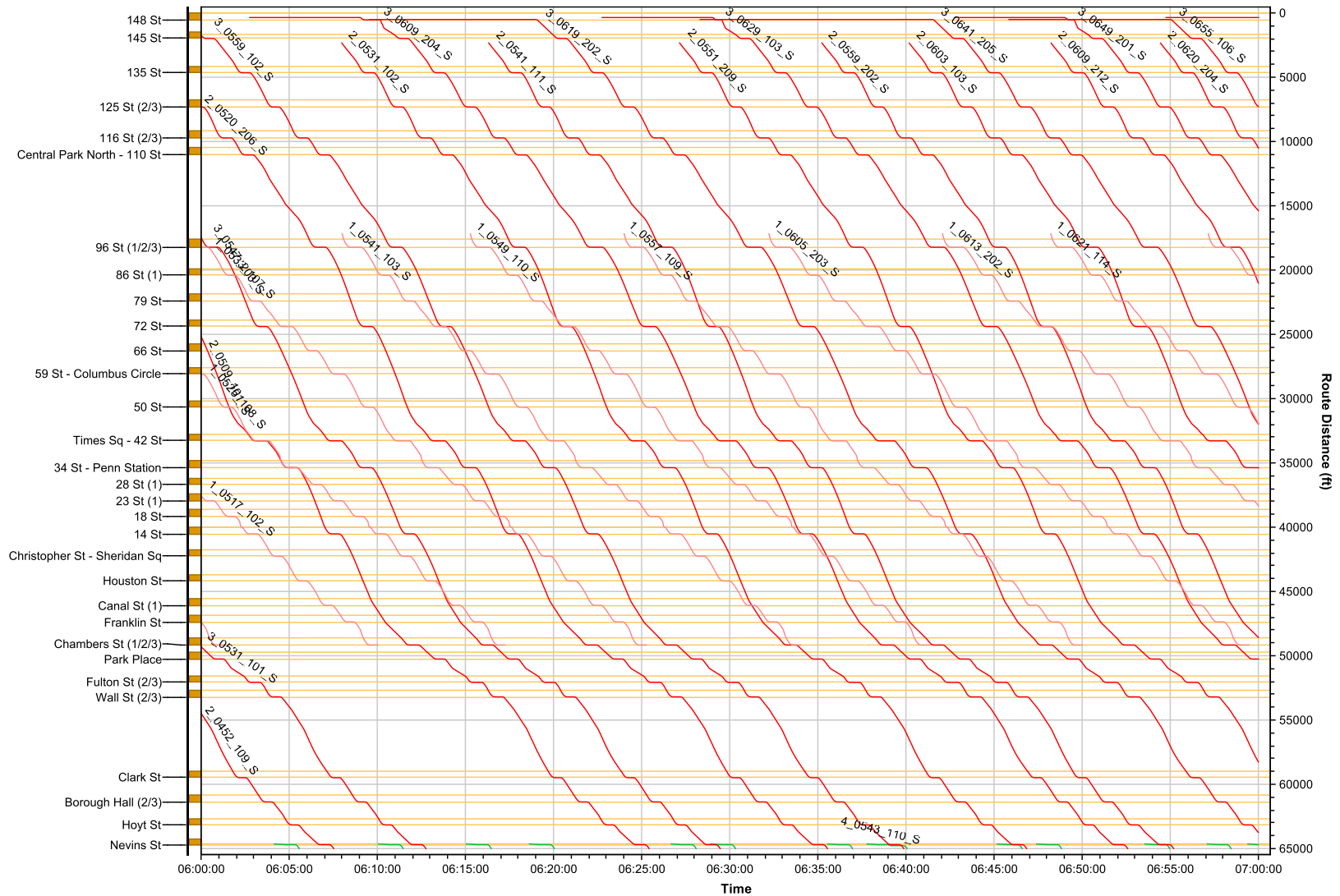
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Figure F.3-136: String Chart – Nevins Street to Harlem-148 Street – Northbound – 6:00 to 7:00 p.m.



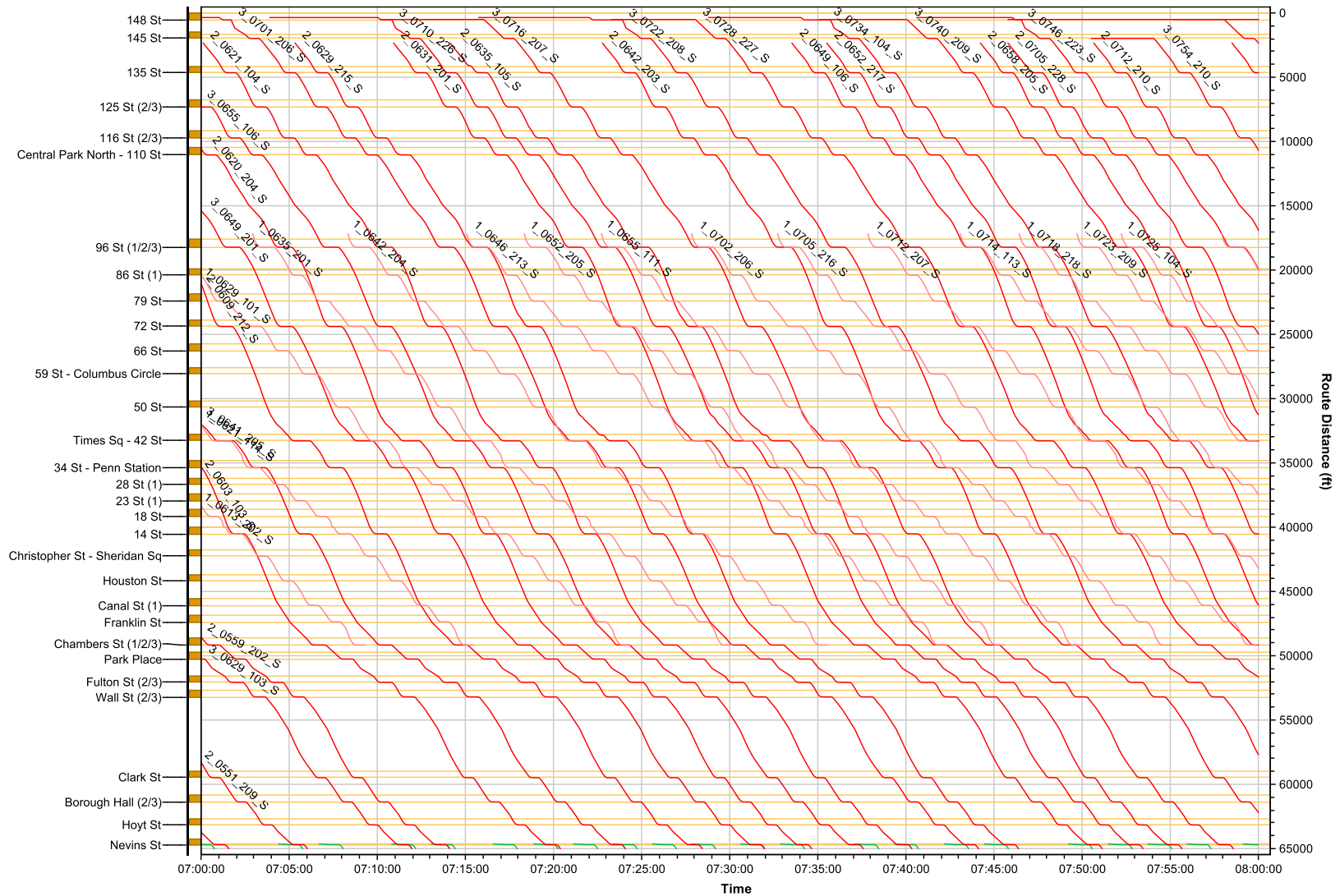
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Figure F.3-137: String Chart – Harlem-148 Street to Nevins Street – Southbound – 6:00 to 7:00 a.m.



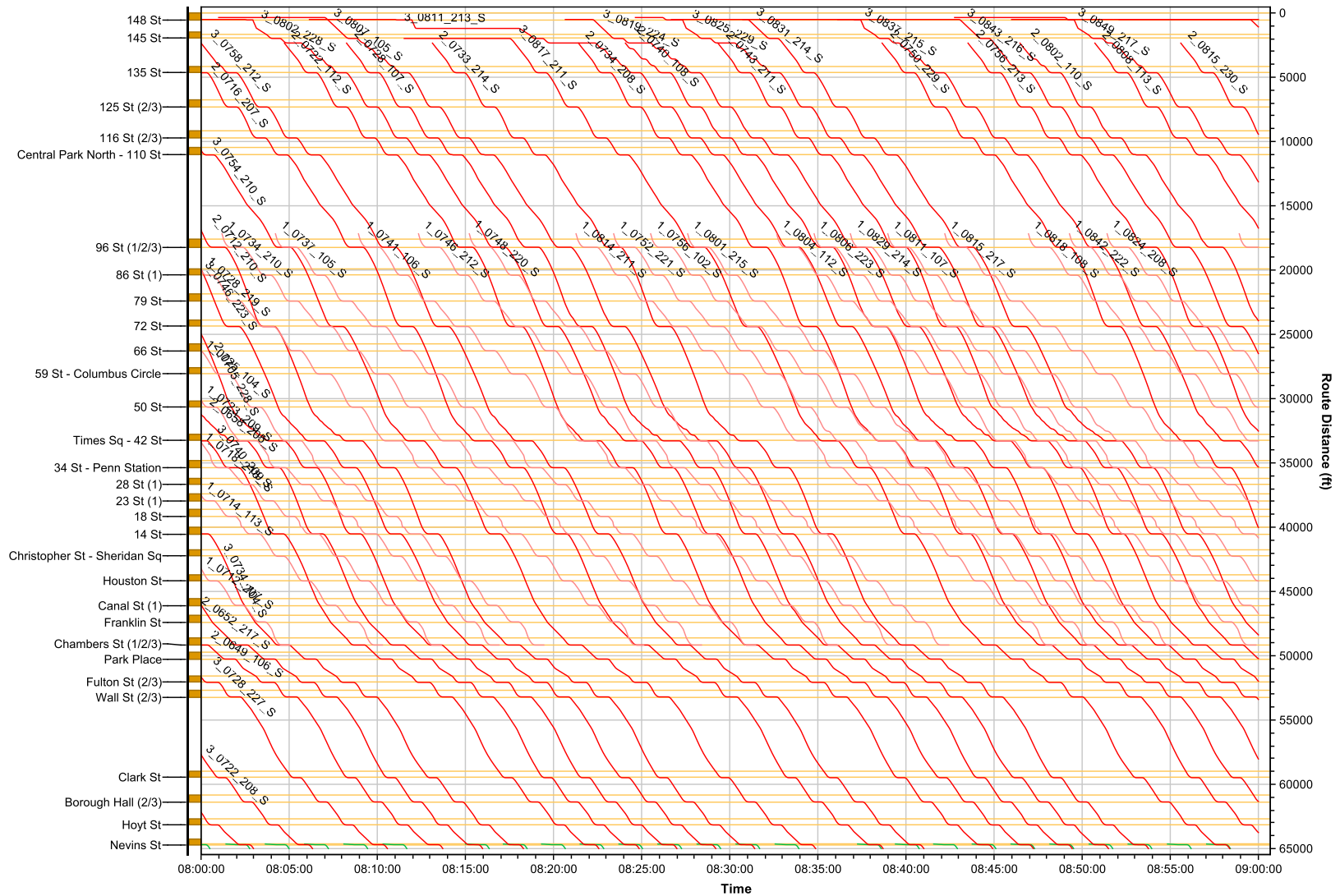
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Figure F.3-138: String Chart – Harlem-148 Street to Nevins Street – Southbound – 7:00 to 8:00 a.m.



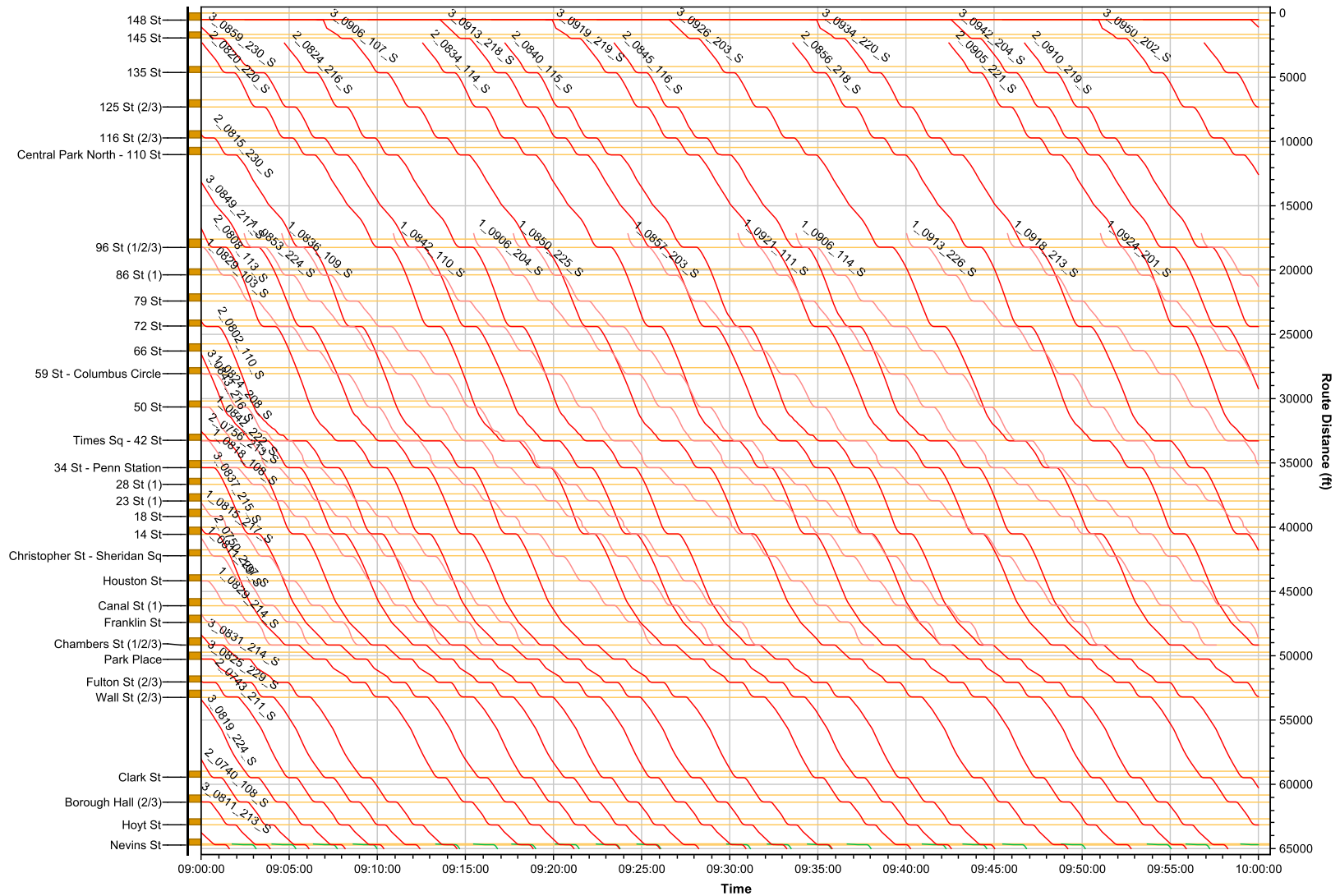
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-139: String Chart – Harlem-148 Street to Nevins Street – Southbound – 8:00 to 9:00 a.m.



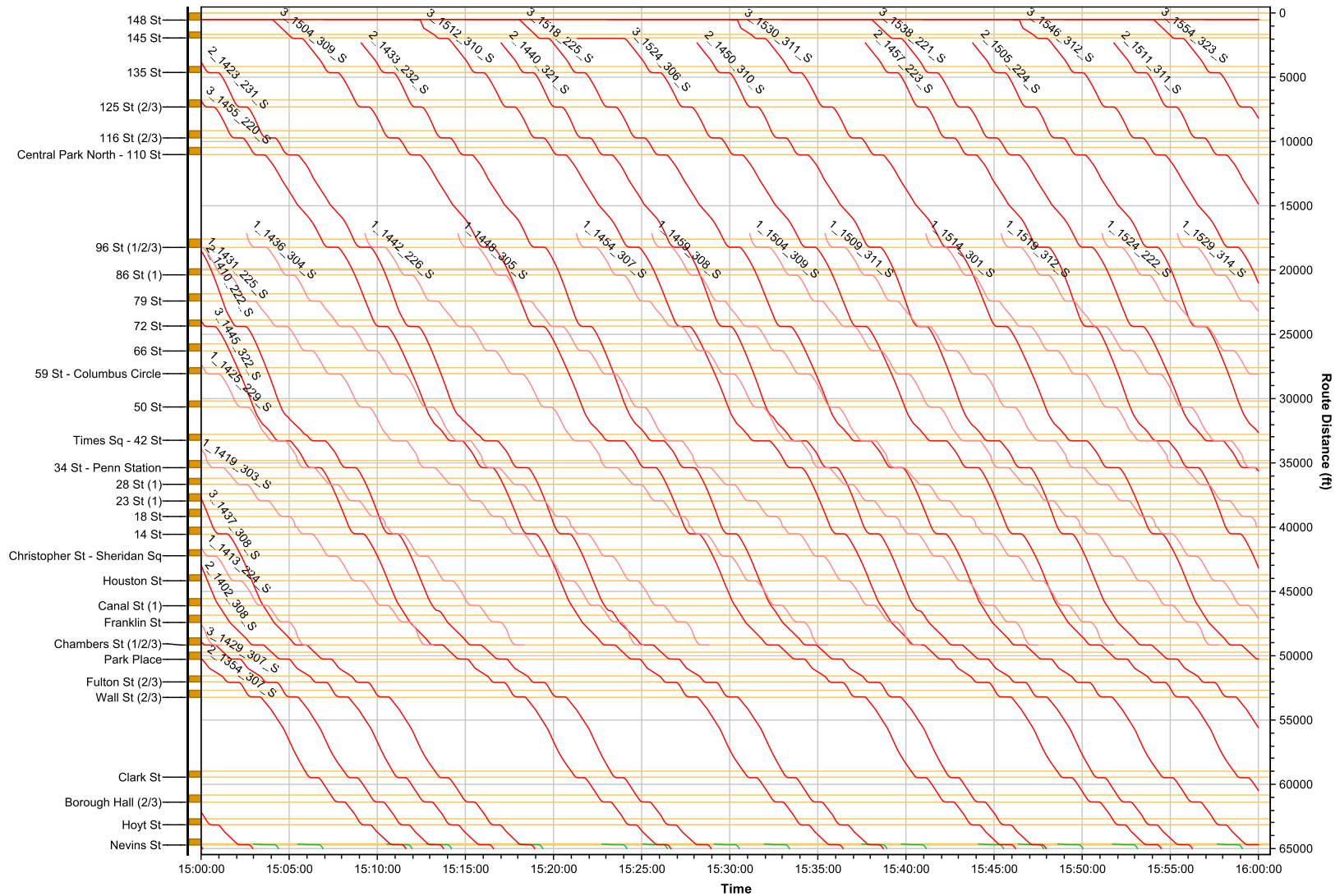
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Figure F.3-140: String Chart – Harlem-148 Street to Nevins Street – Southbound – 9:00 to 10:00 a.m.



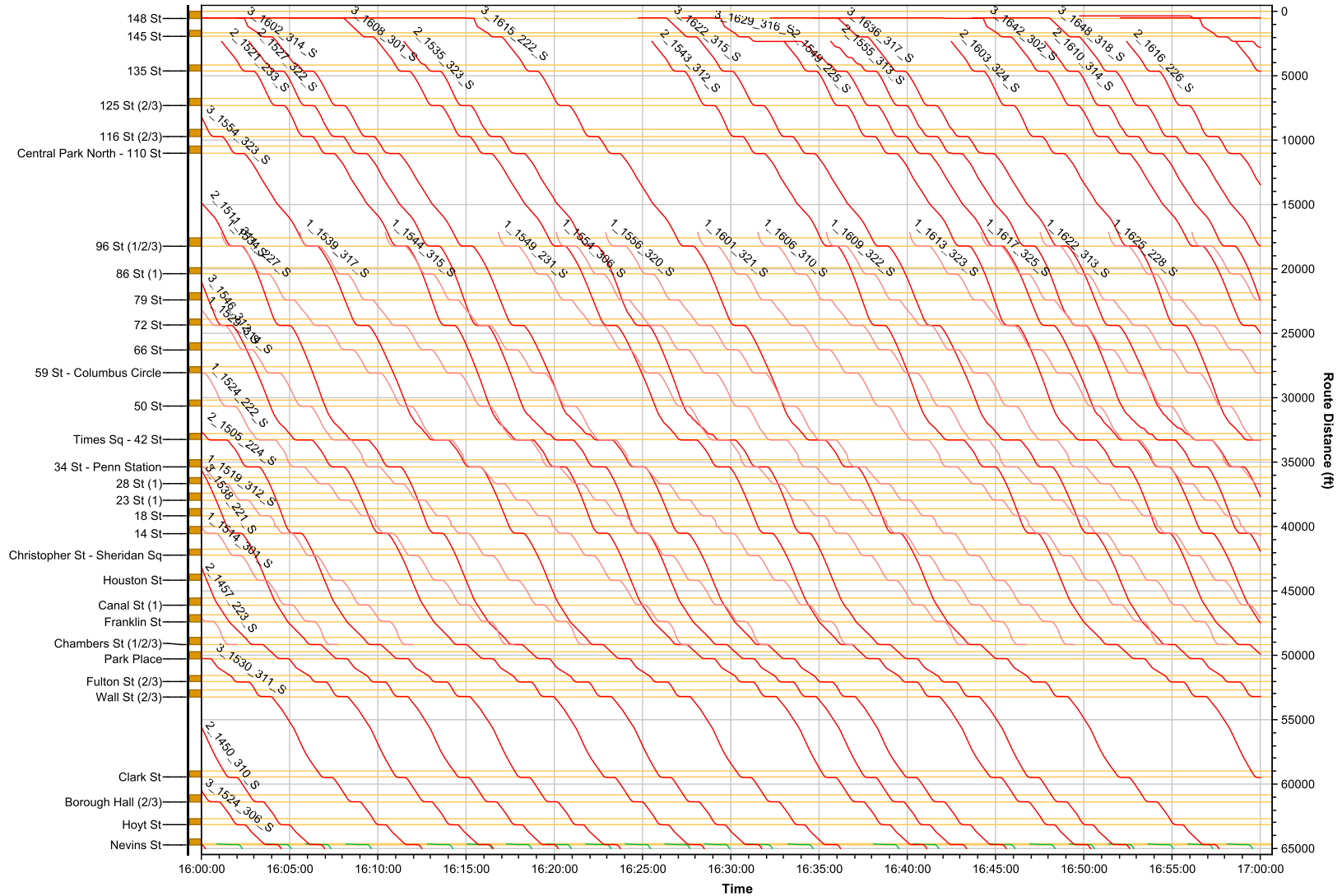
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Figure F.3-141: String Chart – Harlem-148 Street to Nevins Street – Southbound – 3:00 to 4:00 p.m.



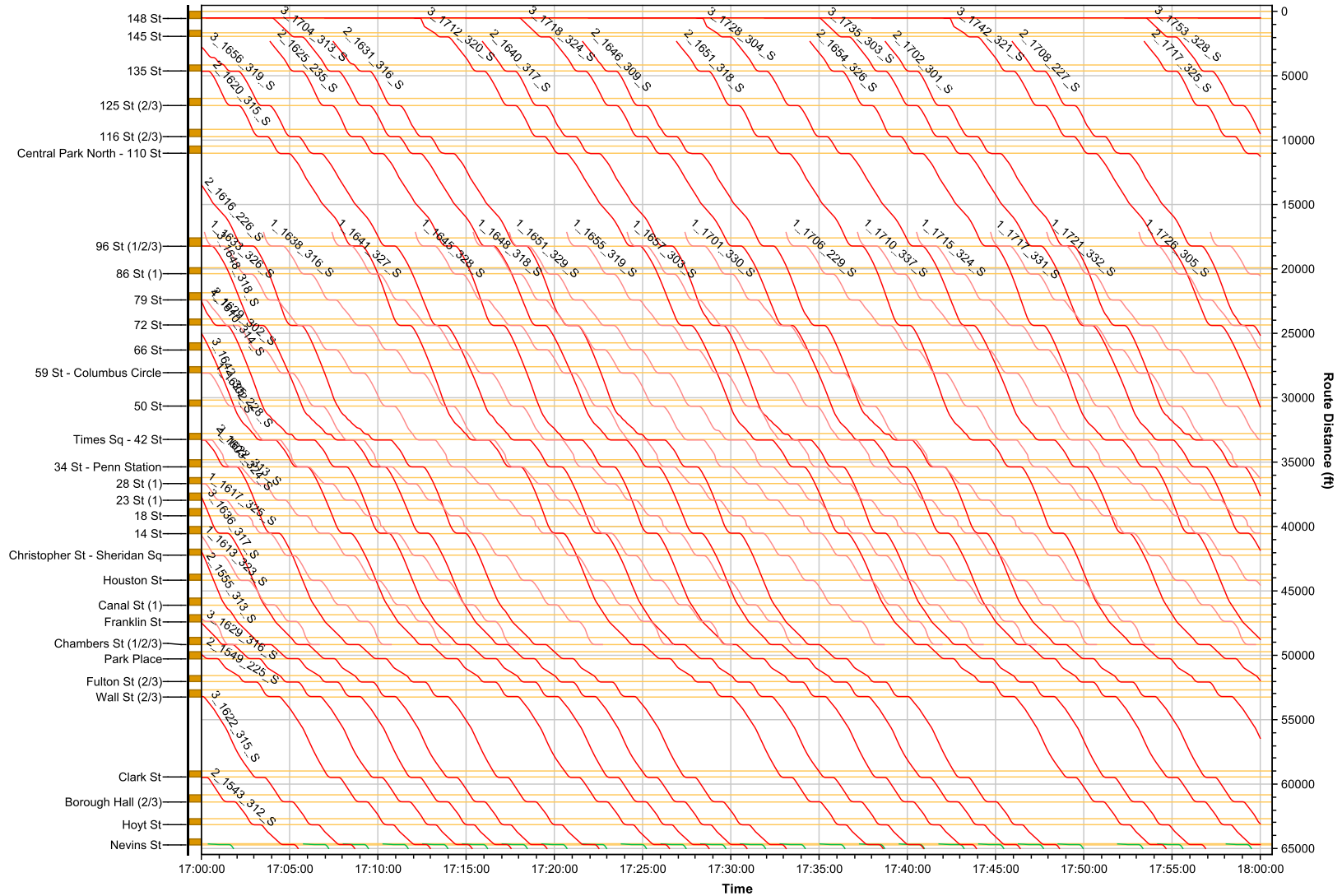
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Figure F.3-142: String Chart – Harlem-148 Street to Nevins Street – Southbound – 4:00 to 5:00 p.m.



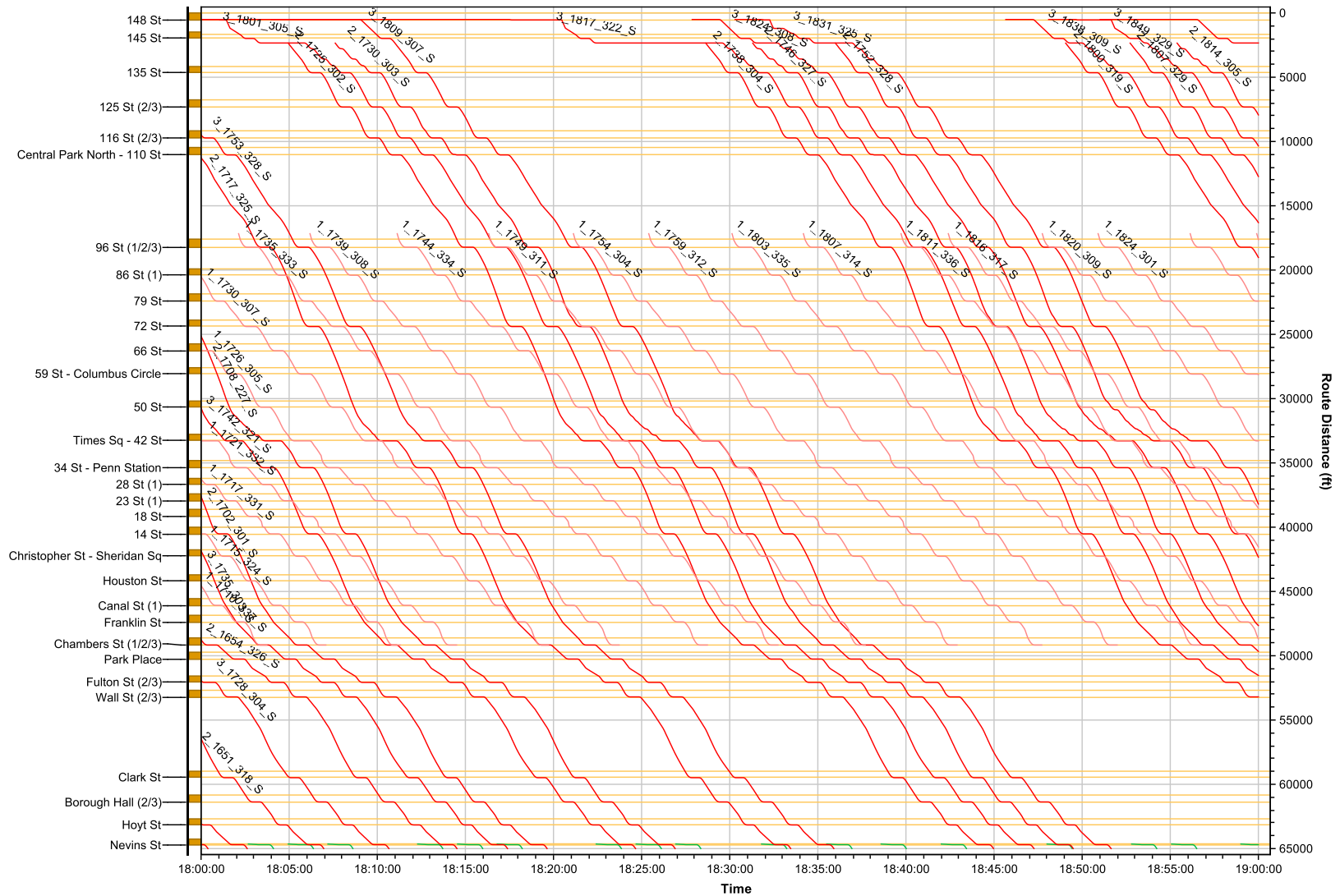
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Figure F.3-143: String Chart – Harlem-148 Street to Nevins Street – Southbound – 5:00 to 6:00 p.m.



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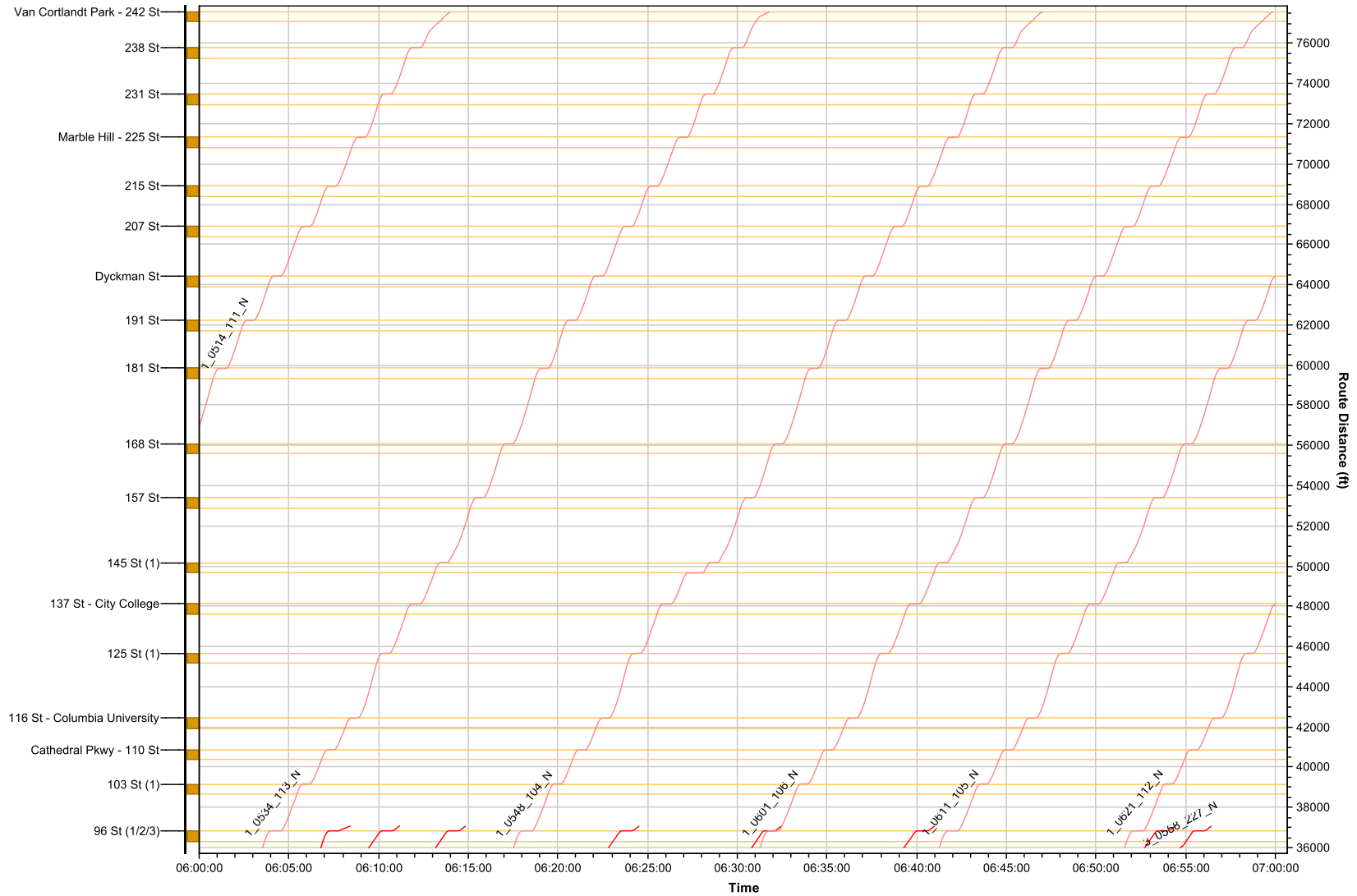
Figure F.3-144: String Chart – Harlem-148 Street to Nevins Street – Southbound – 6:00 to 7:00 p.m.



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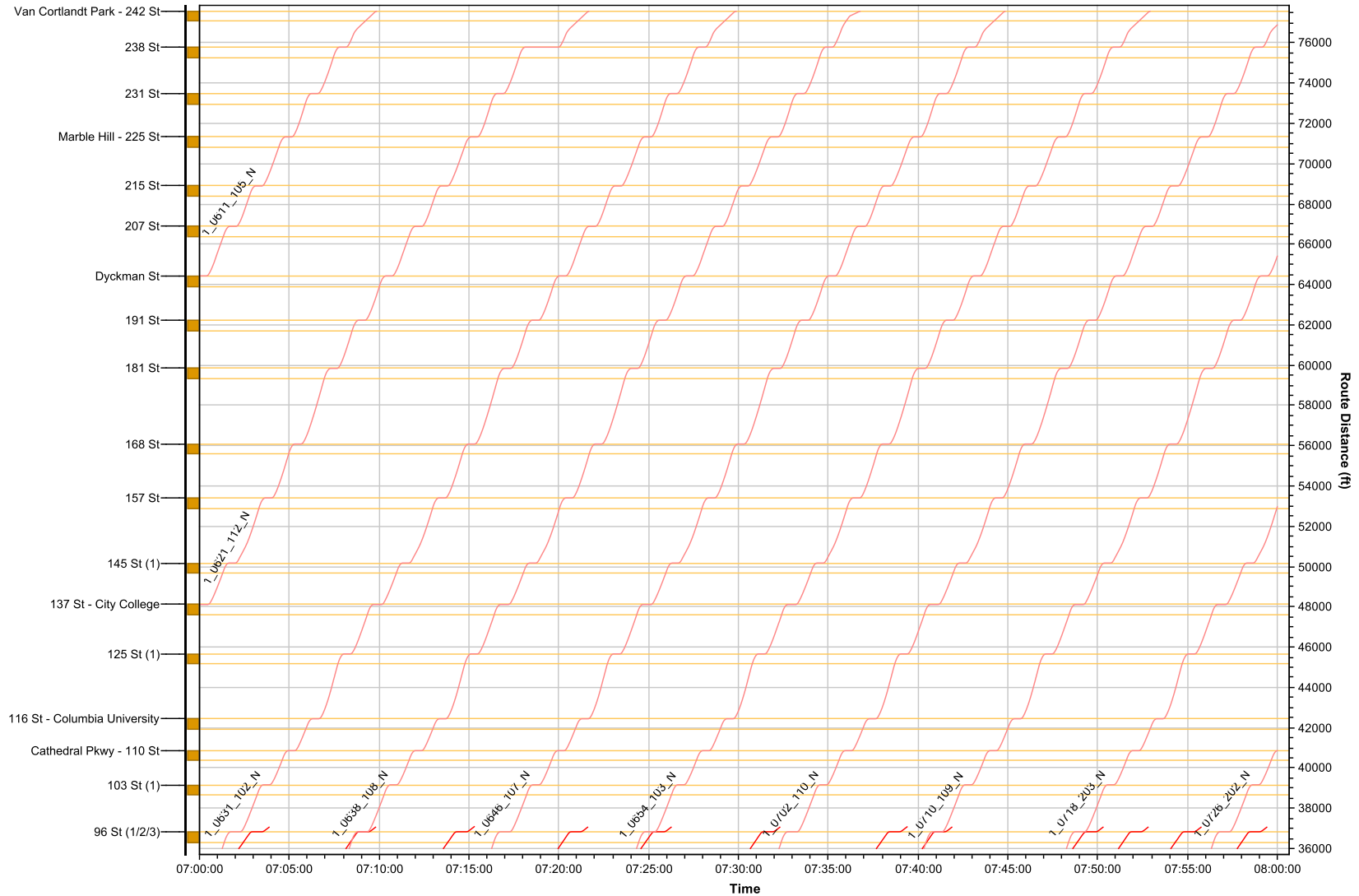
F.3.10 Van Cortlandt Park-242 Street to 96 Street

Figure F.3-145: String Chart – 96 Street to Van Cortlandt Park-242 Street – Northbound – 6:00 to 7:00 a.m.



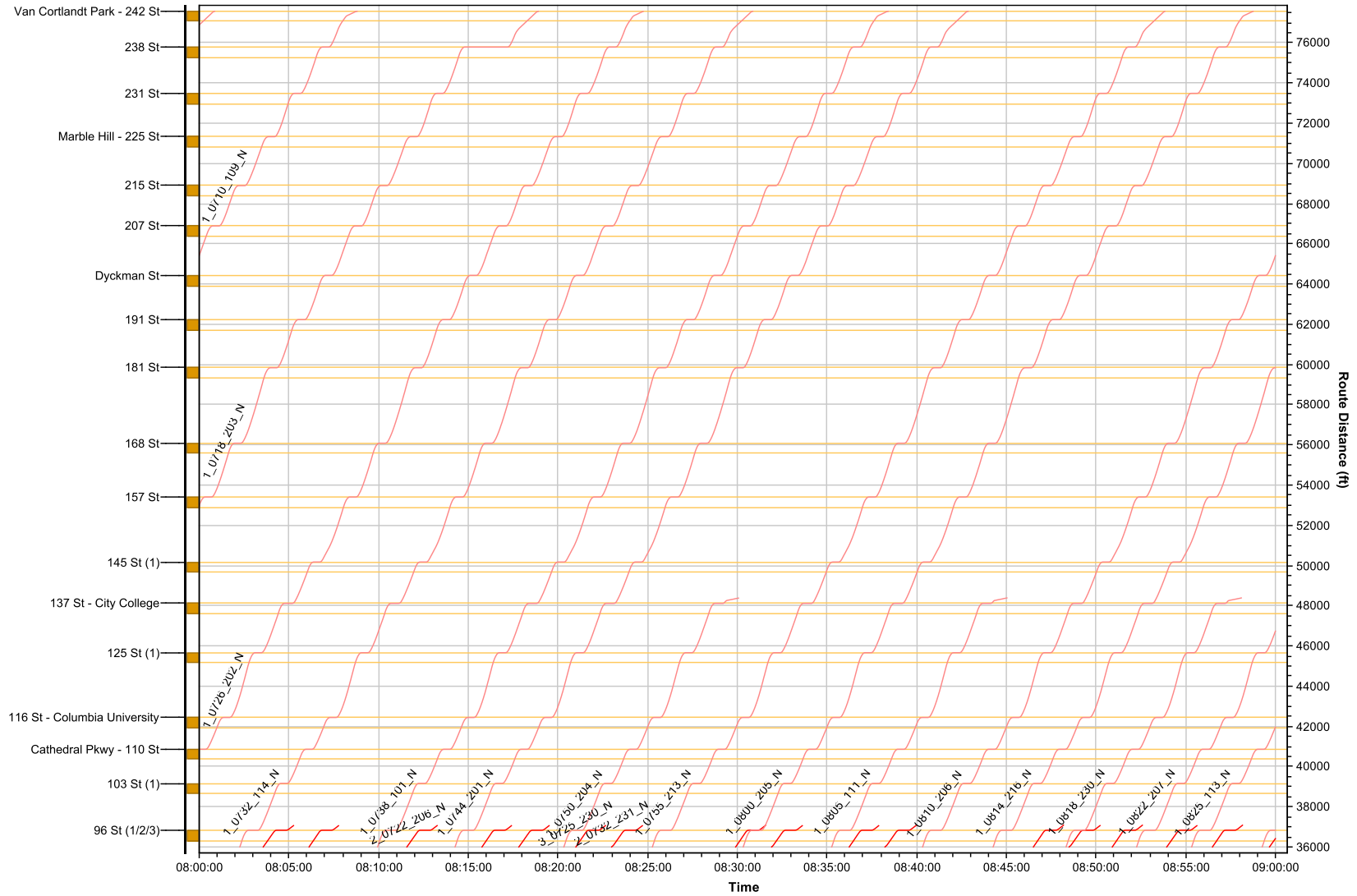
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Figure F.3-146: String Chart – 96 Street to Van Cortlandt Park-242 Street – Northbound – 7:00 to 8:00 a.m.



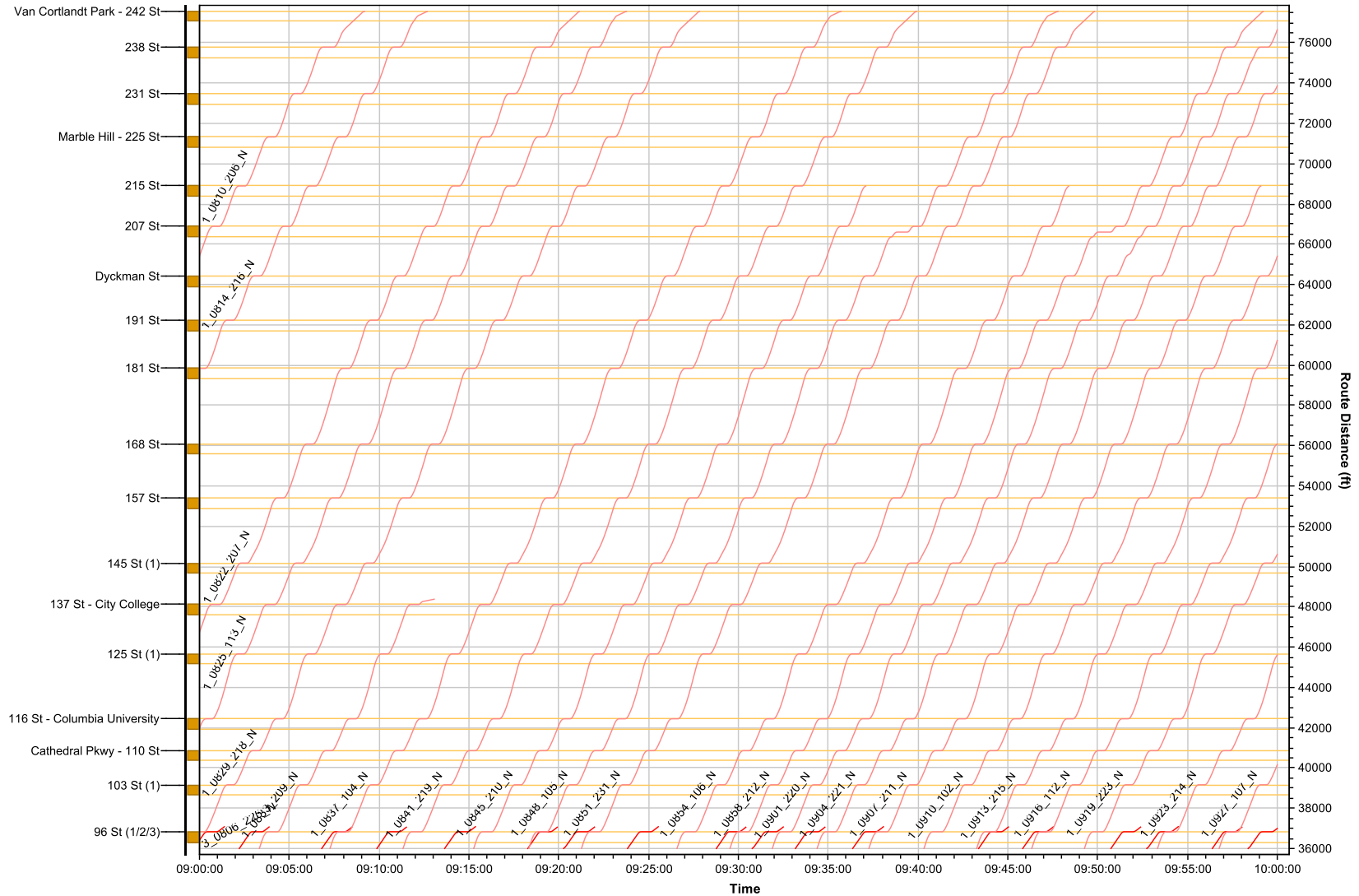
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Figure F.3-147: String Chart – 96 Street to Van Cortlandt Park-242 Street – Northbound – 8:00 to 9:00 a.m.



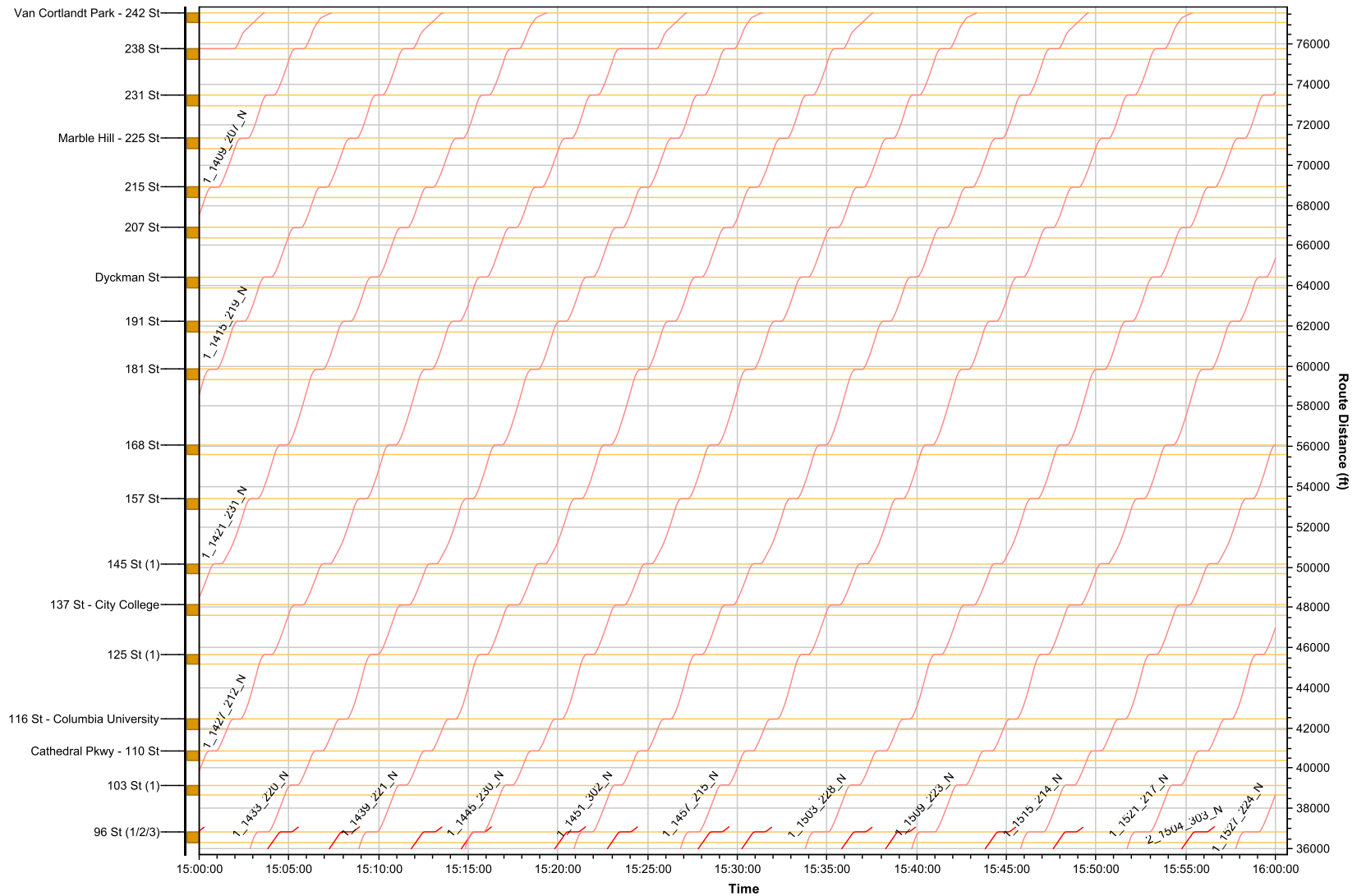
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-148: String Chart – 96 Street to Van Cortlandt Park-242 Street – Northbound – 9:00 to 10:00 a.m.



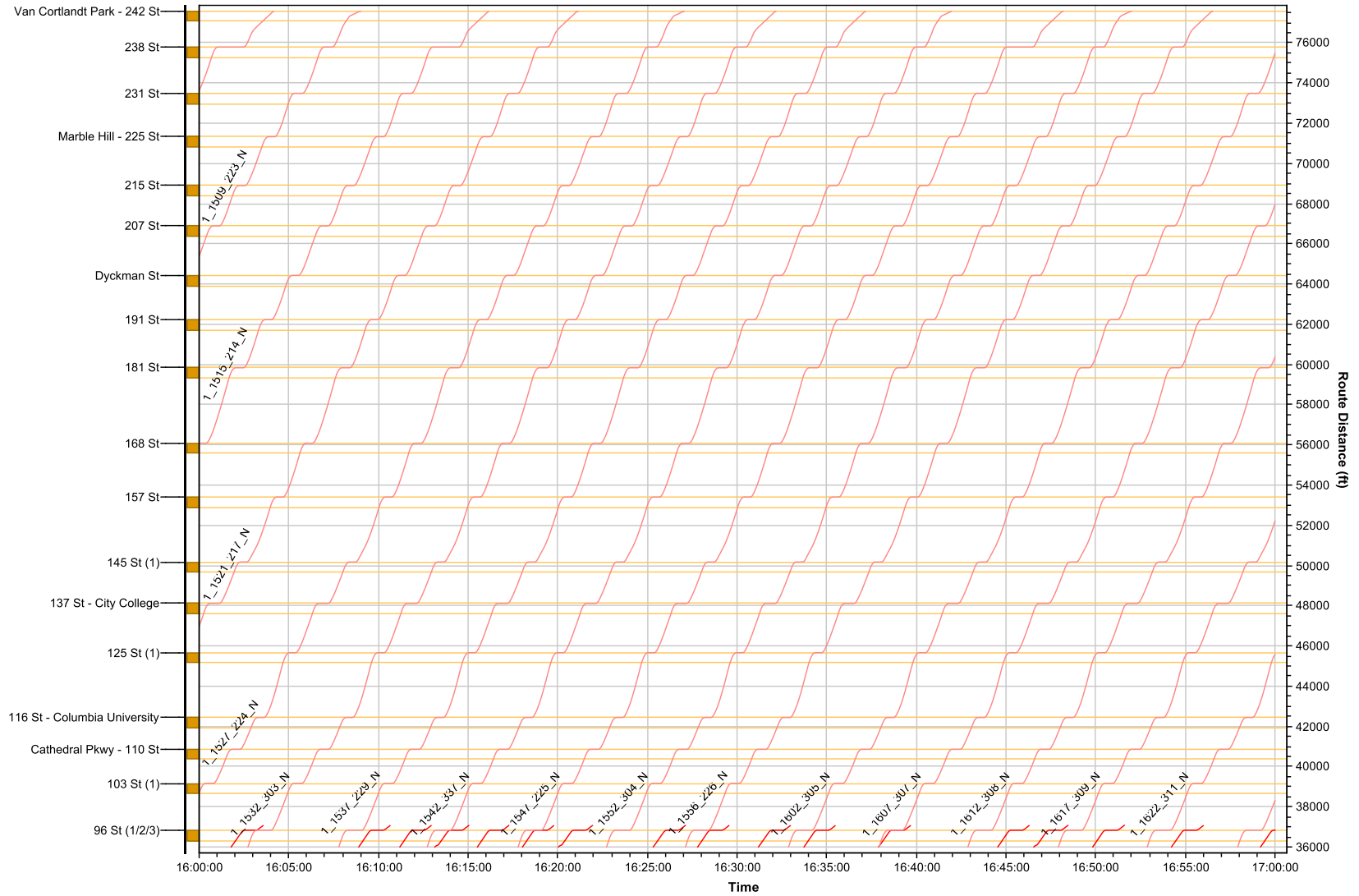
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-149: String Chart – 96 Street to Van Cortlandt Park-242 Street – Northbound – 3:00 to 4:00 p.m.



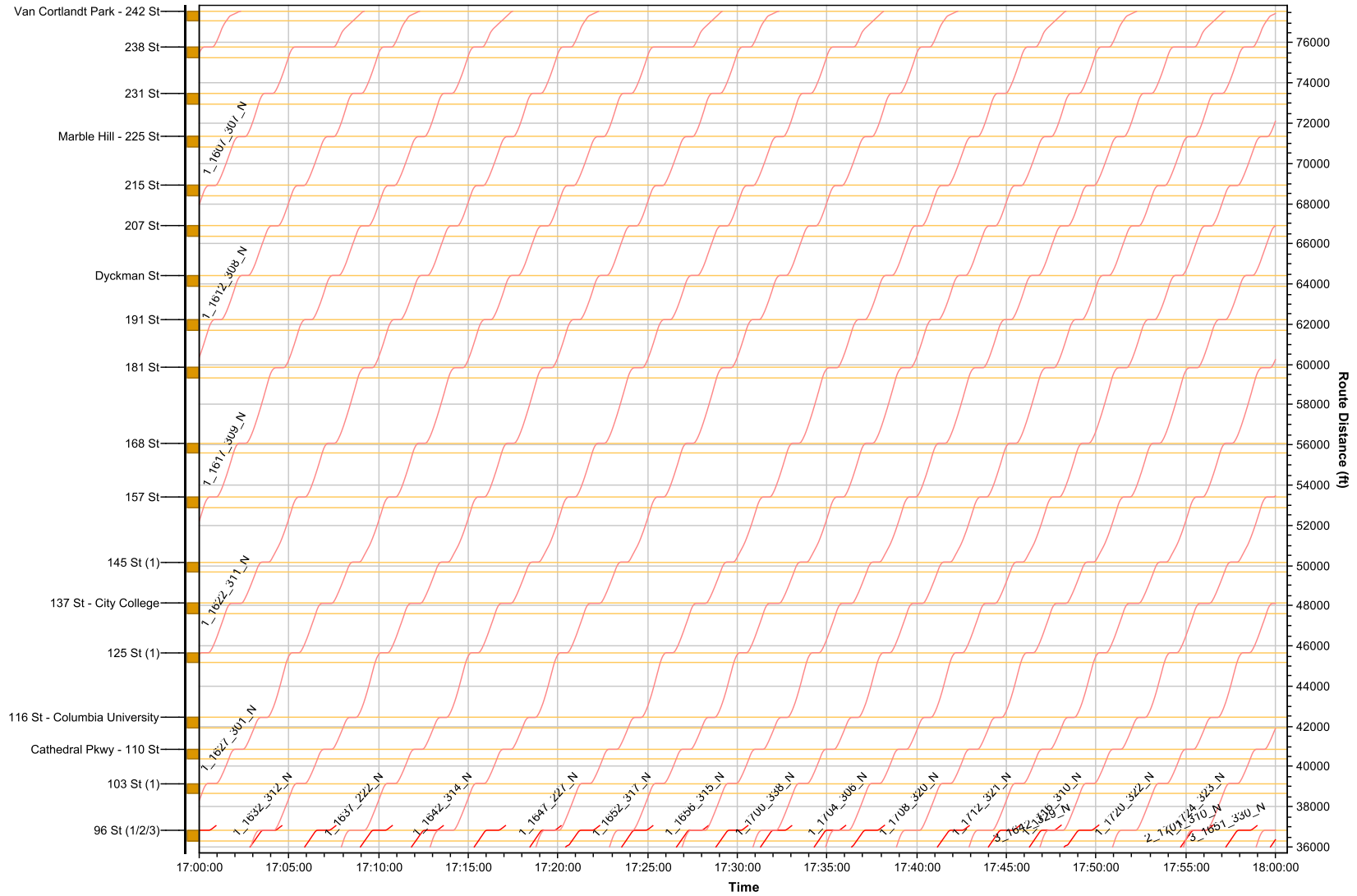
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Figure F.3-150: String Chart – 96 Street to Van Cortlandt Park-242 Street – Northbound – 4:00 to 5:00 p.m.



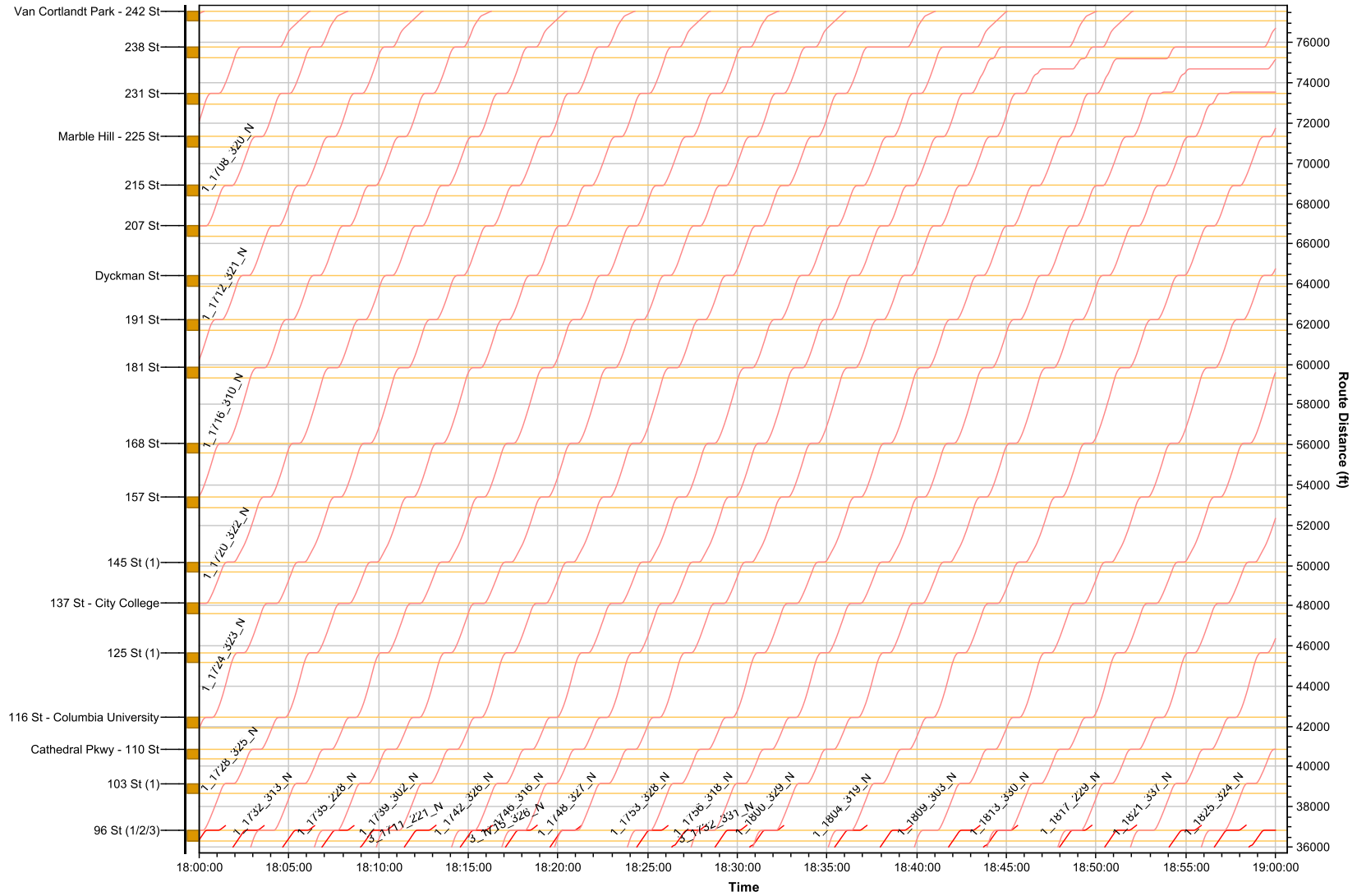
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Figure F.3-151: String Chart – 96 Street to Van Cortlandt Park-242 Street – Northbound – 5:00 to 6:00 p.m.



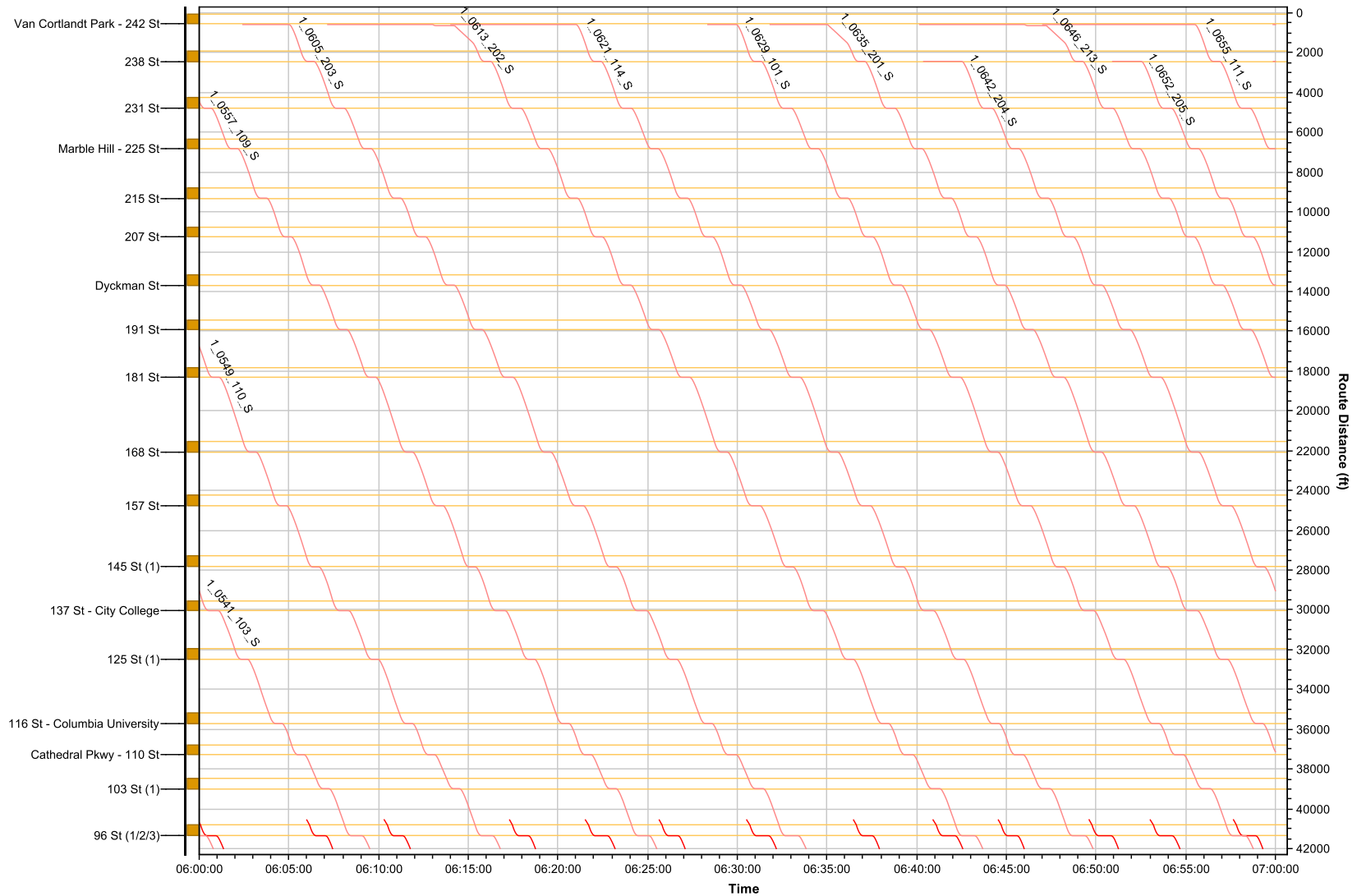
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Figure F.3-152: String Chart – 96 Street to Van Cortlandt Park-242 Street – Northbound – 6:00 to 7:00 p.m.



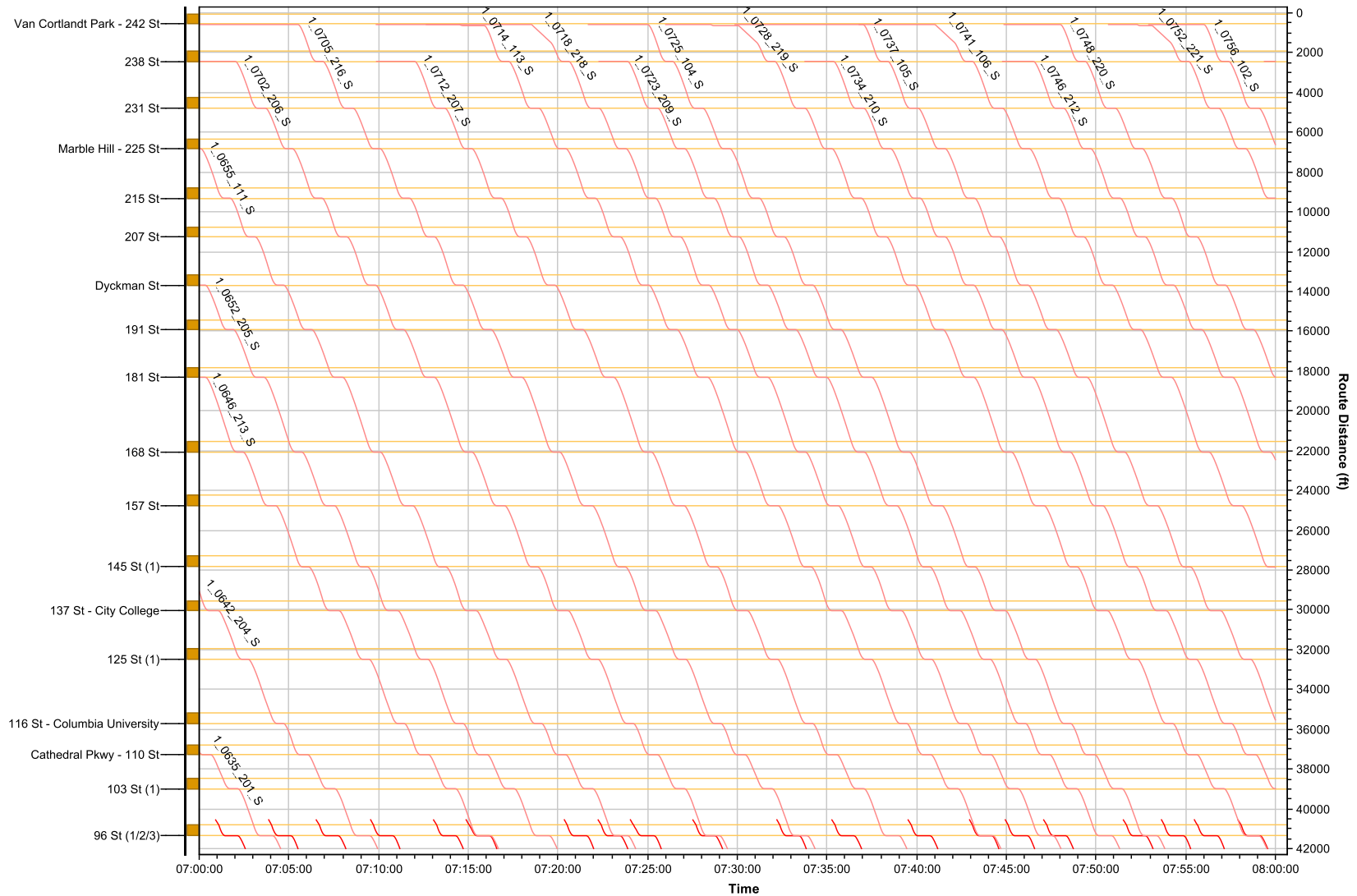
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Figure F.3-153: String Chart – Van Cortlandt Park-242 Street to 96 Street – Southbound – 6:00 to 7:00 a.m.



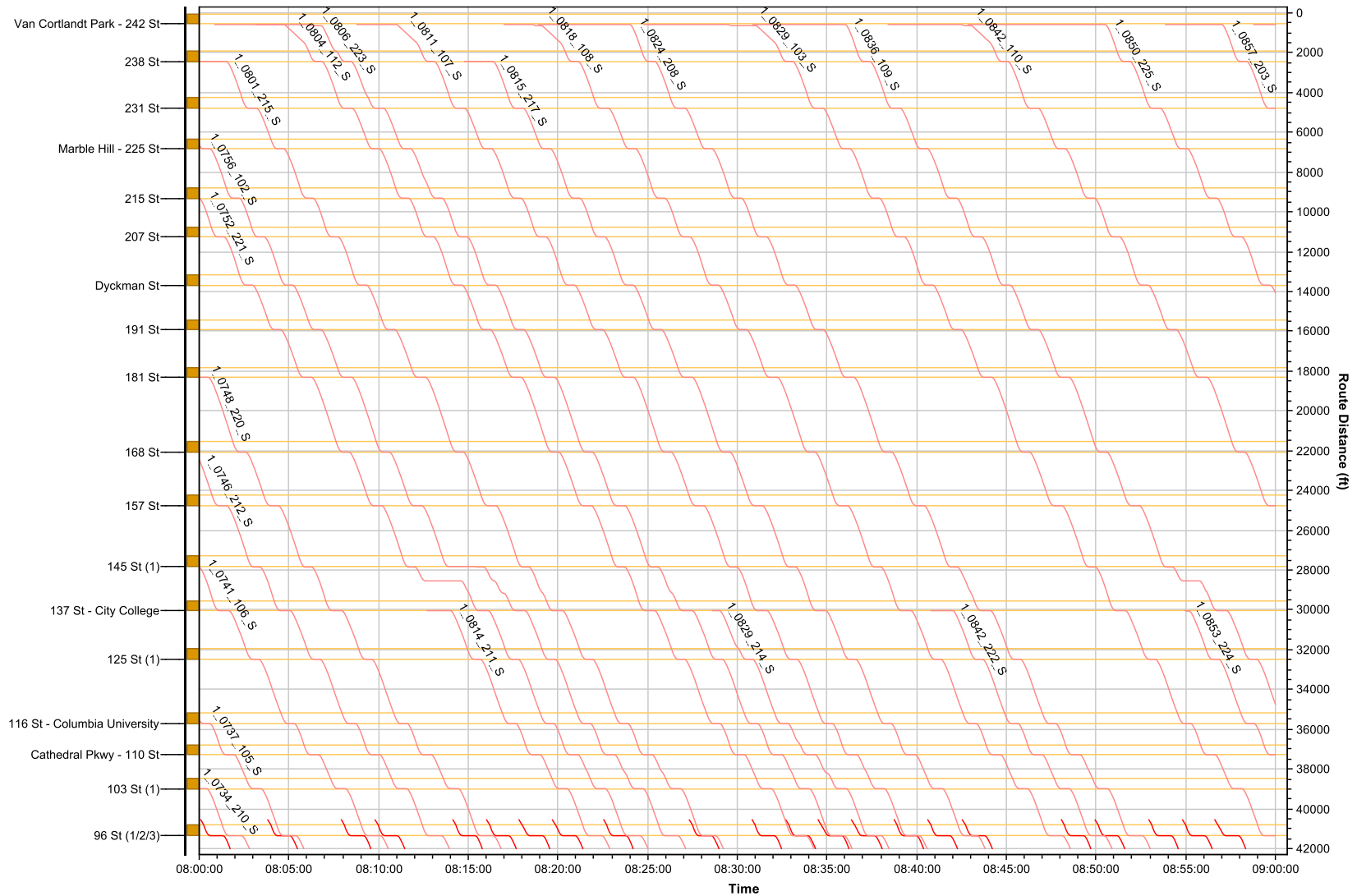
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Figure F.3-154: String Chart – Van Cortlandt Park-242 Street to 96 Street – Southbound – 7:00 to 8:00 a.m.



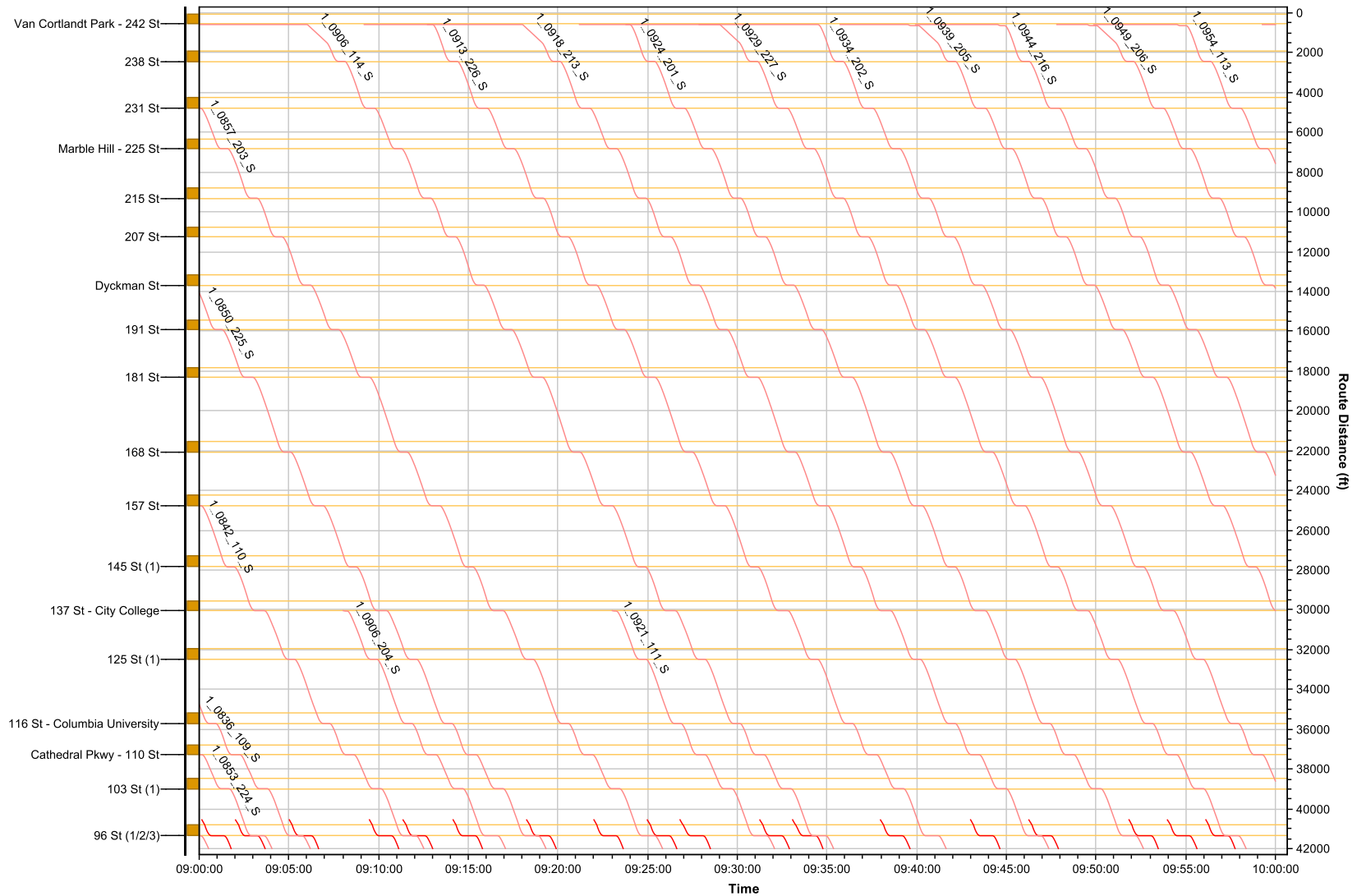
APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Figure F.3-155: String Chart – Van Cortlandt Park-242 Street to 96 Street – Southbound – 8:00 to 9:00 a.m.



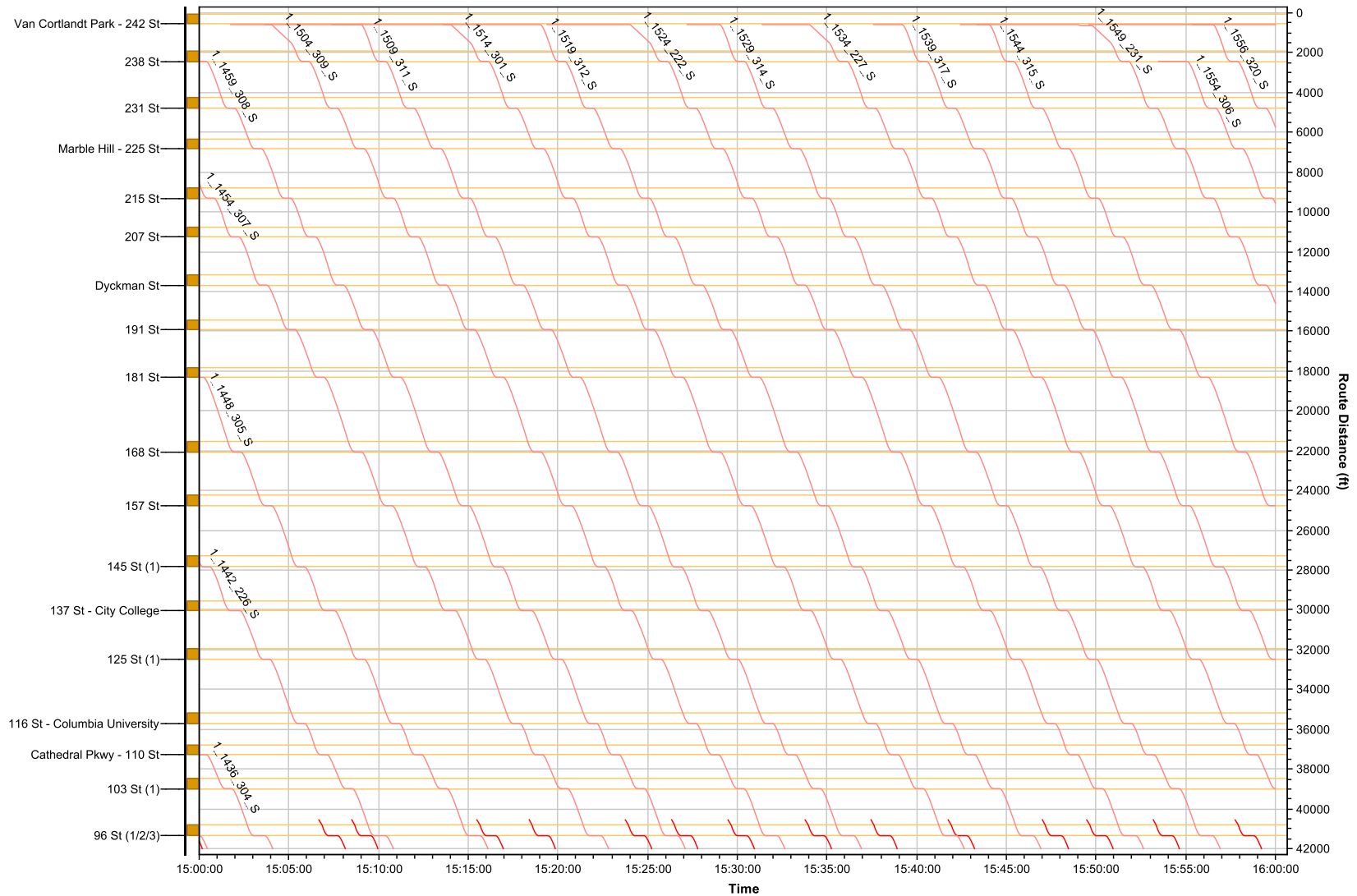
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Figure F.3-156: String Chart – Van Cortlandt Park-242 Street to 96 Street – Southbound – 9:00 to 10:00 a.m.



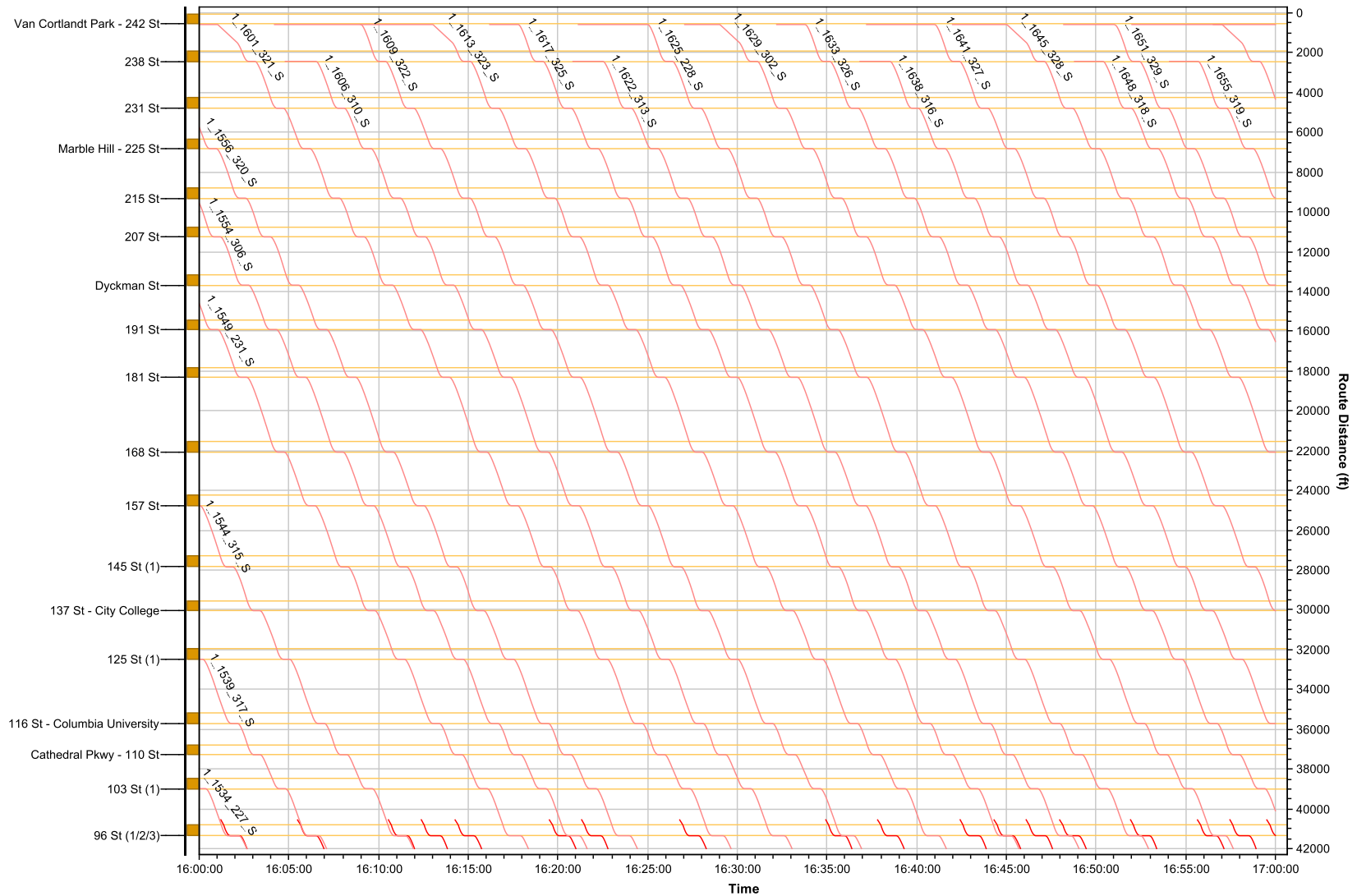
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Figure F.3-157: String Chart – Van Cortlandt Park-242 Street to 96 Street – Southbound – 3:00 to 4:00 p.m.



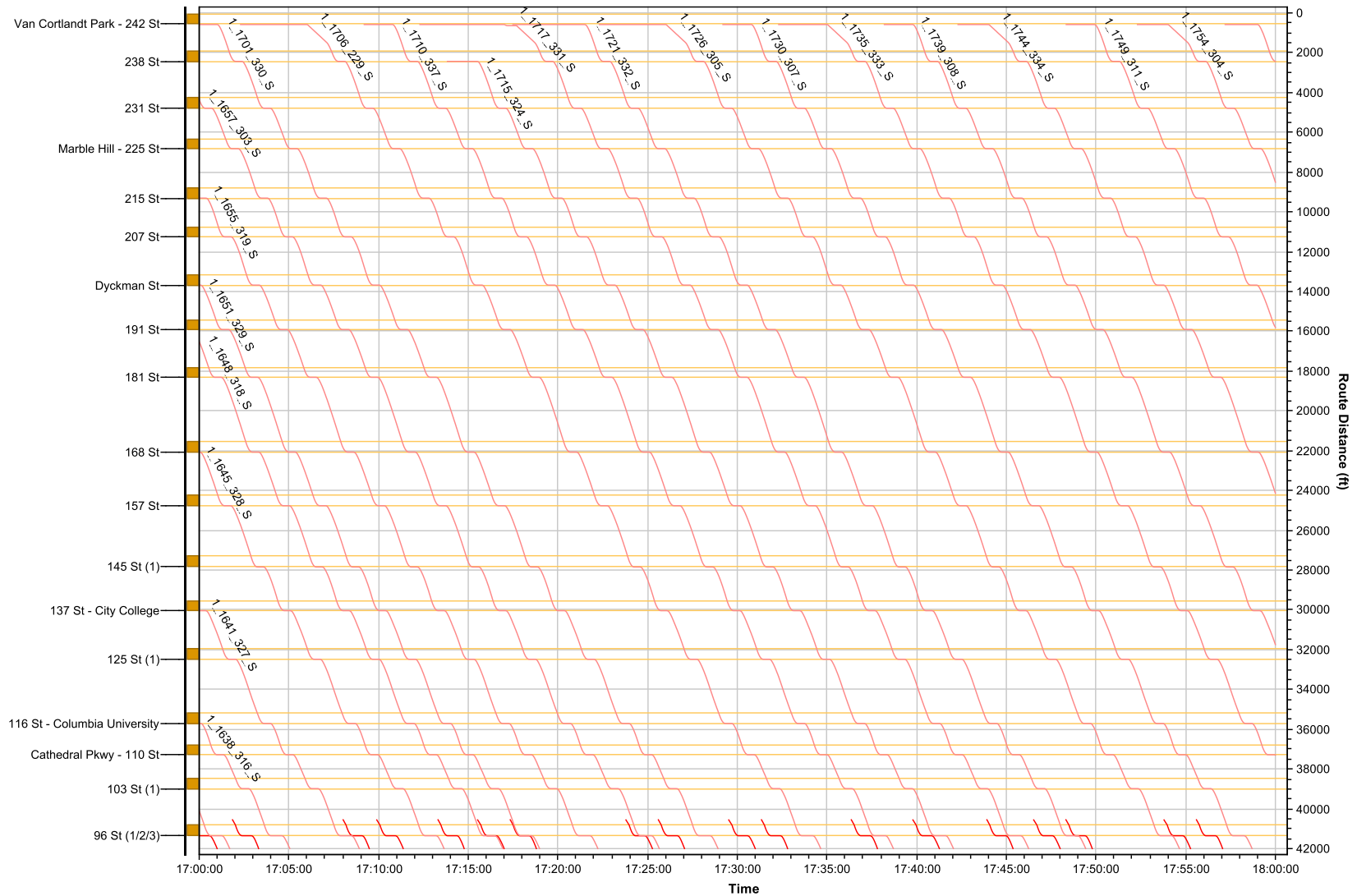
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Figure F.3-158: String Chart – Van Cortlandt Park-242 Street to 96 Street – Southbound – 4:00 to 5:00 p.m.



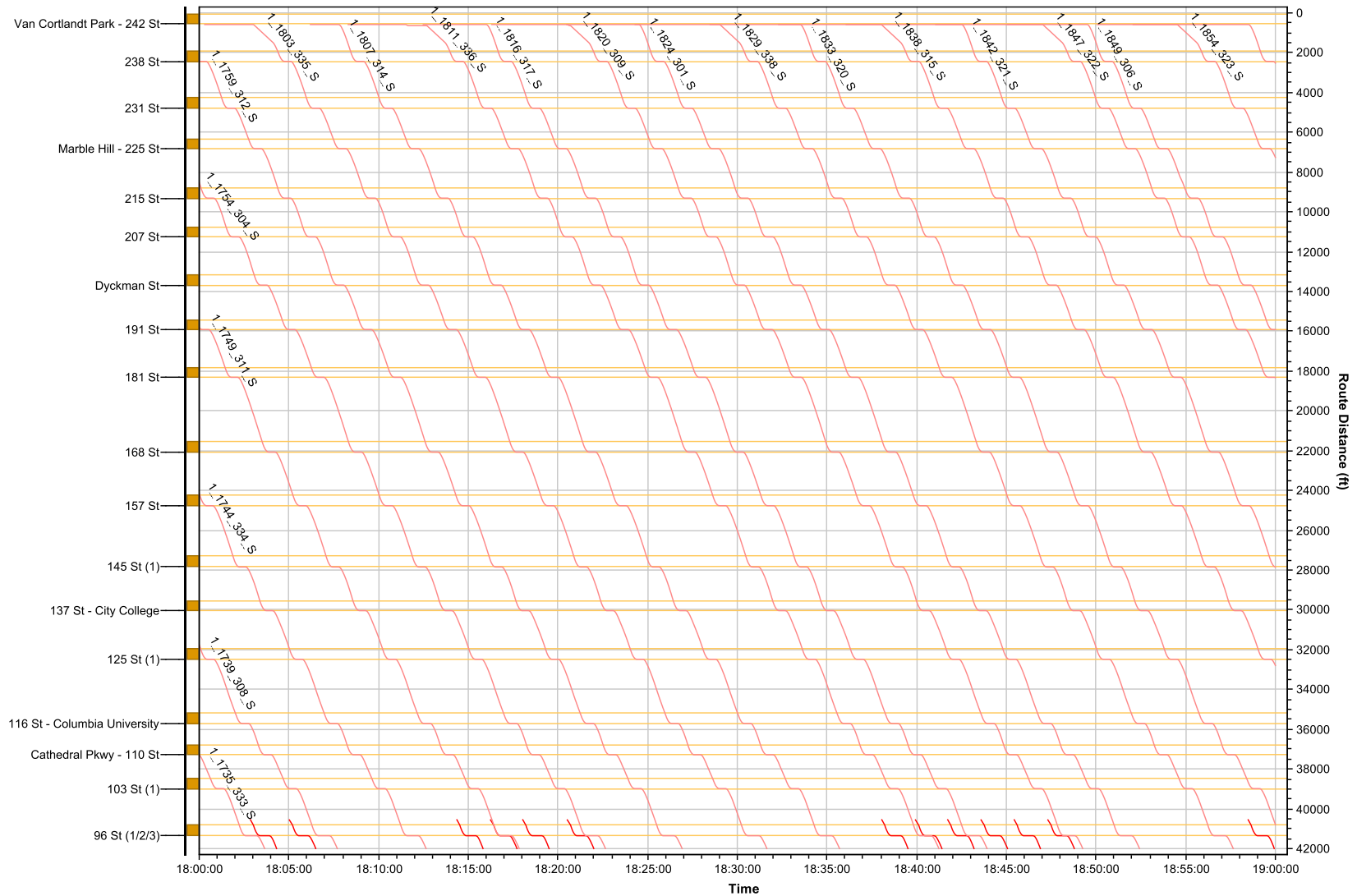
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Figure F.3-159: String Chart – Van Cortlandt Park-242 Street to 96 Street – Southbound – 5:00 to 6:00 p.m.



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Figure F.3-160: String Chart – Van Cortlandt Park-242 Street to 96 Street – Southbound – 6:00 to 7:00 p.m.

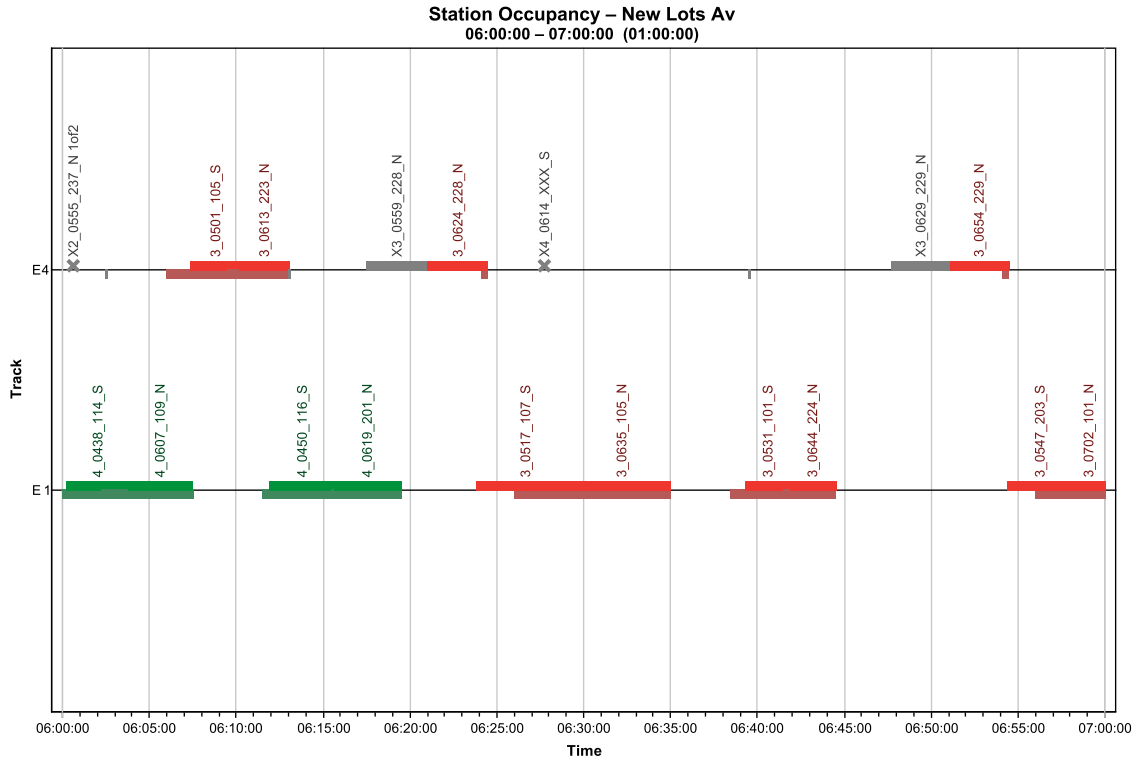


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F.4 Simulated Station Occupancy Charts

F.4.1 New Lots Avenue

Figure F.4-1: Station Occupancy Chart – New Lots Avenue – 6:00 to 7:00 a.m.



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Figure F.4-2: Station Occupancy Chart - New Lots Avenue - 7:00 to 8:00 a.m.

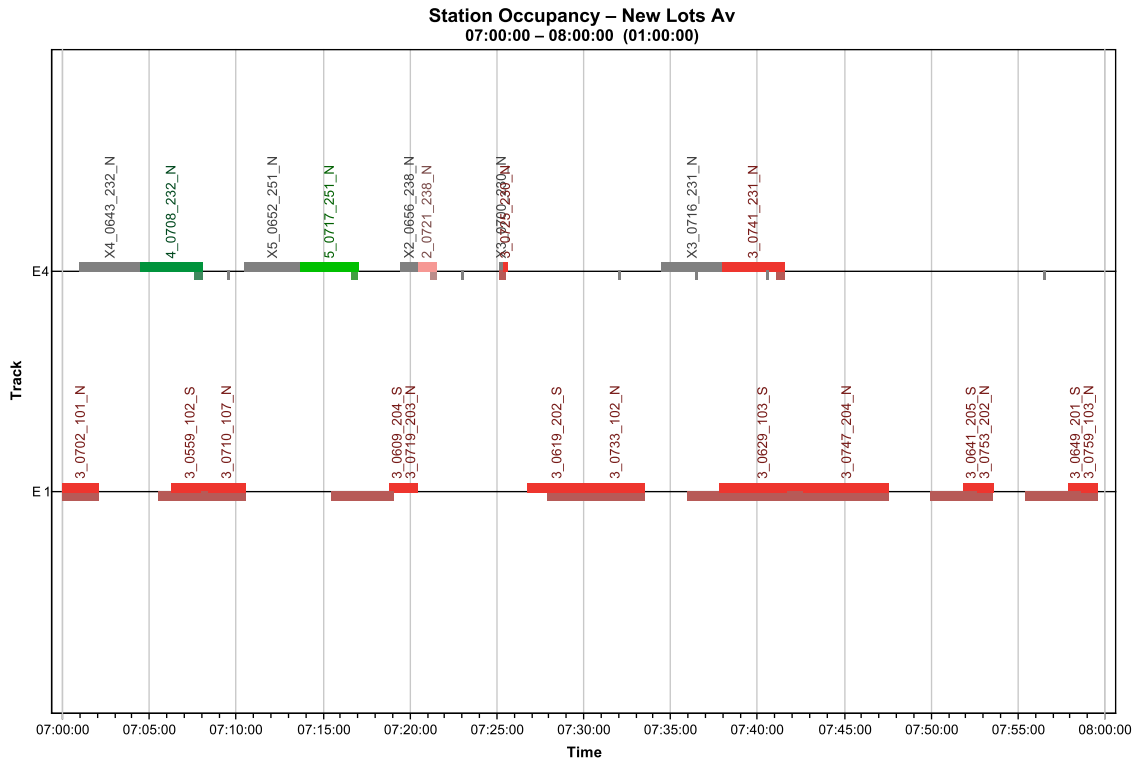
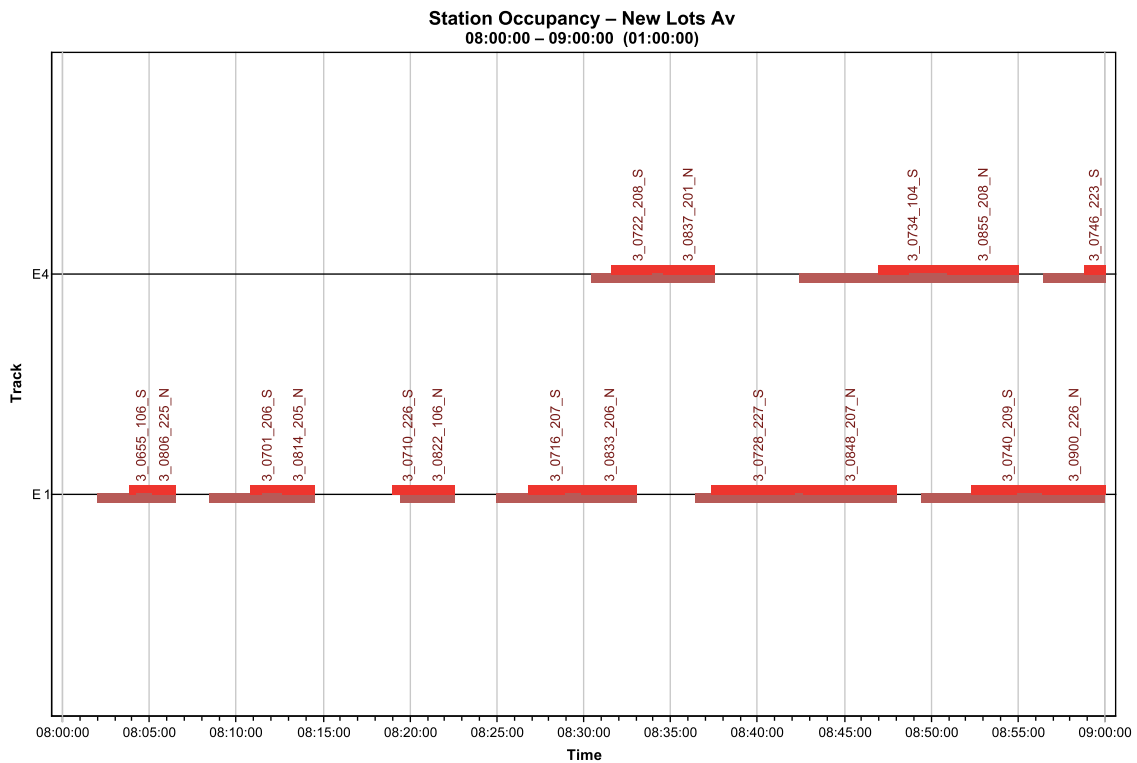


Figure F.4-3: Station Occupancy Chart - New Lots Avenue - 8:00 to 9:00 a.m.



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Figure F.4-4: Station Occupancy Chart - New Lots Avenue - 9:00 to 10:00 a.m.

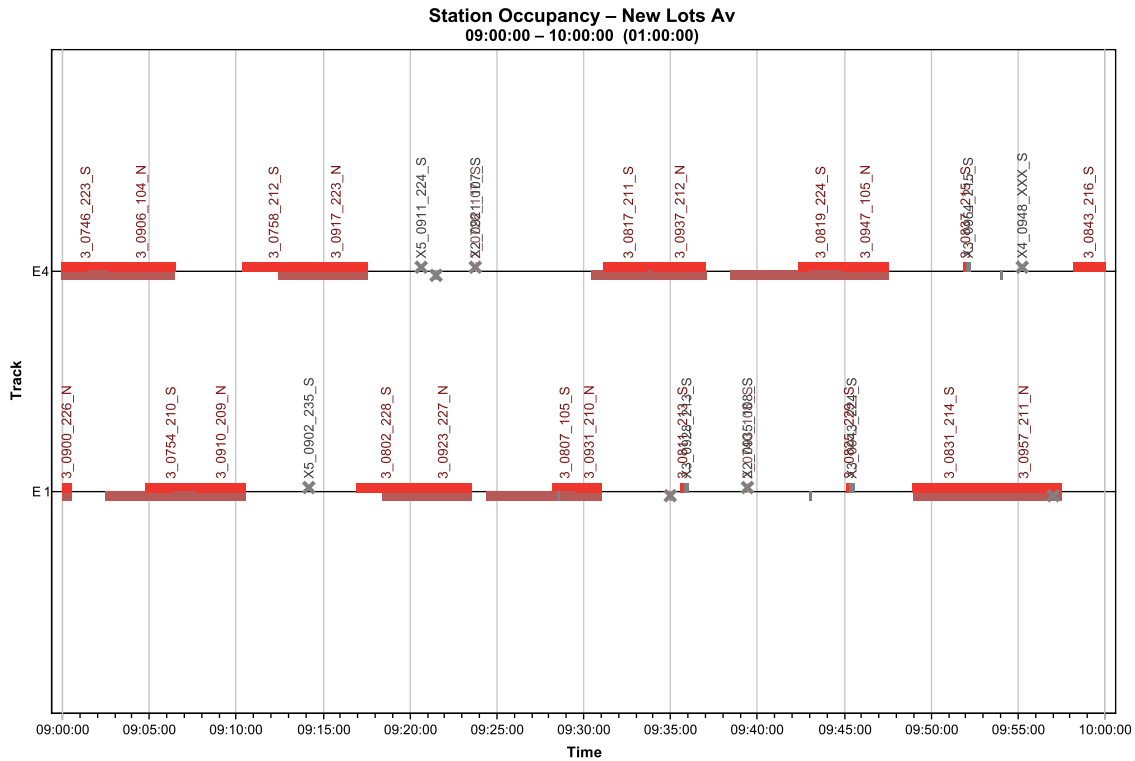
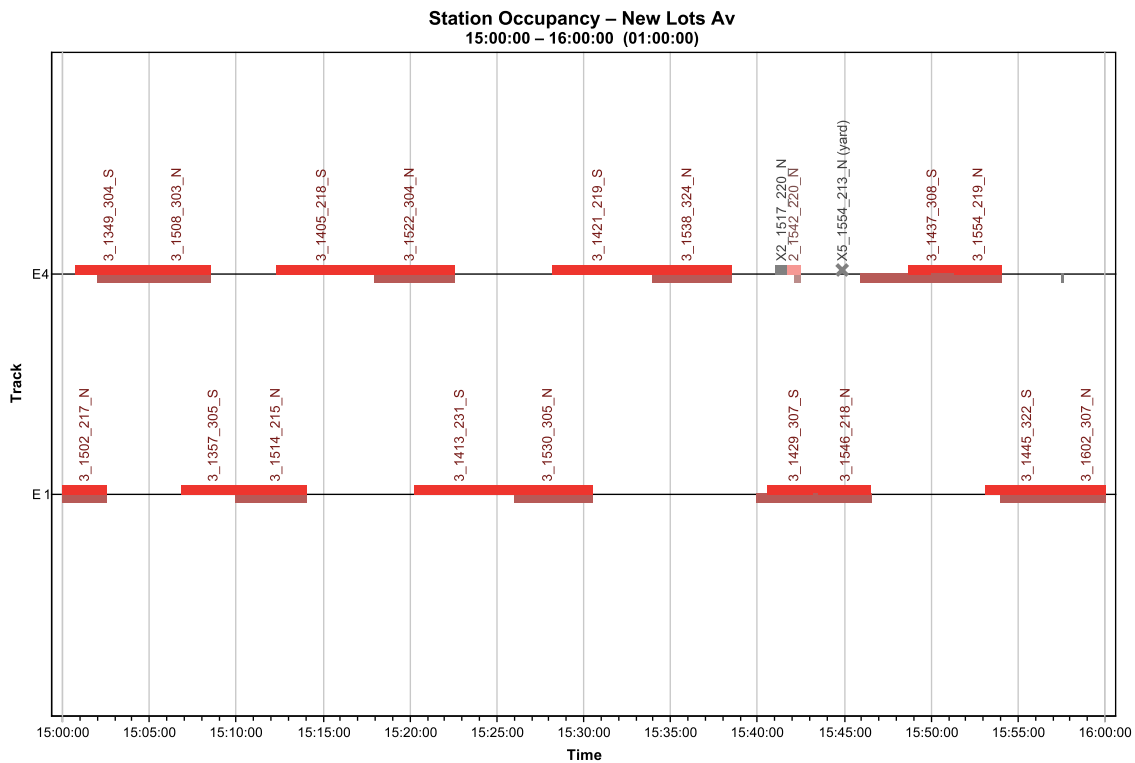


Figure F.4-5: Station Occupancy Chart - New Lots Avenue - 3:00 to 4:00 p.m.



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Figure F.4-6: Station Occupancy Chart - New Lots Avenue - 4:00 to 5:00 p.m.

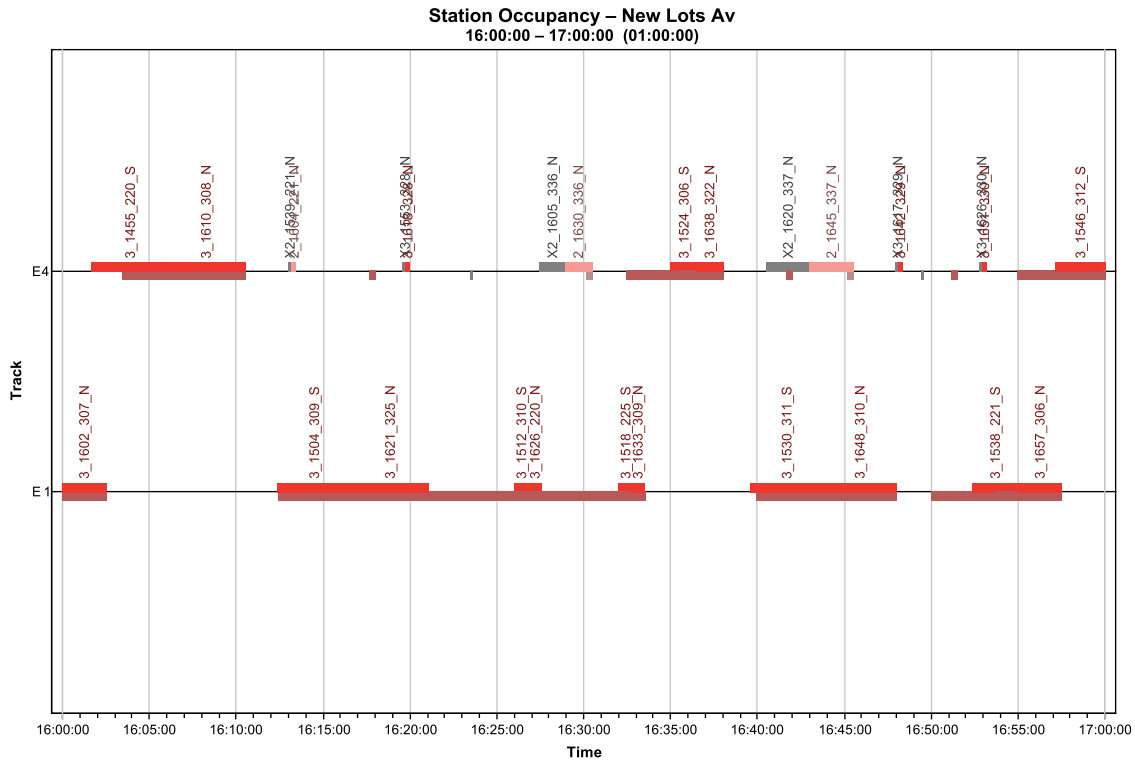
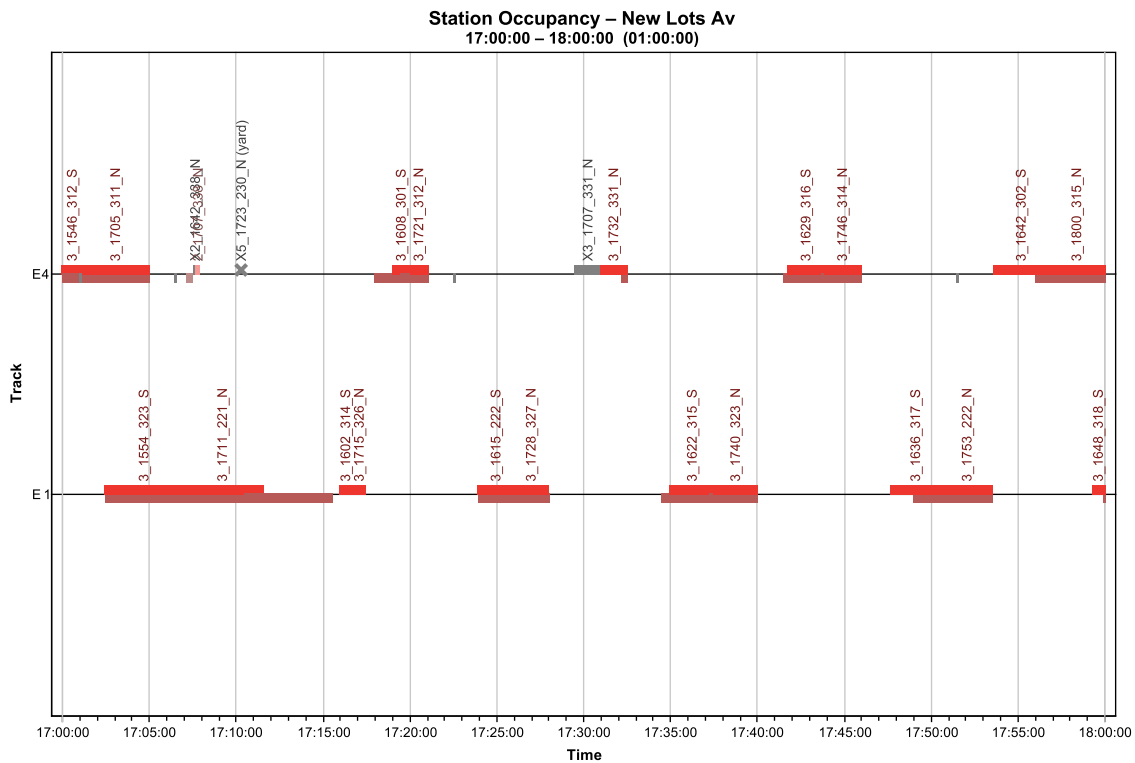
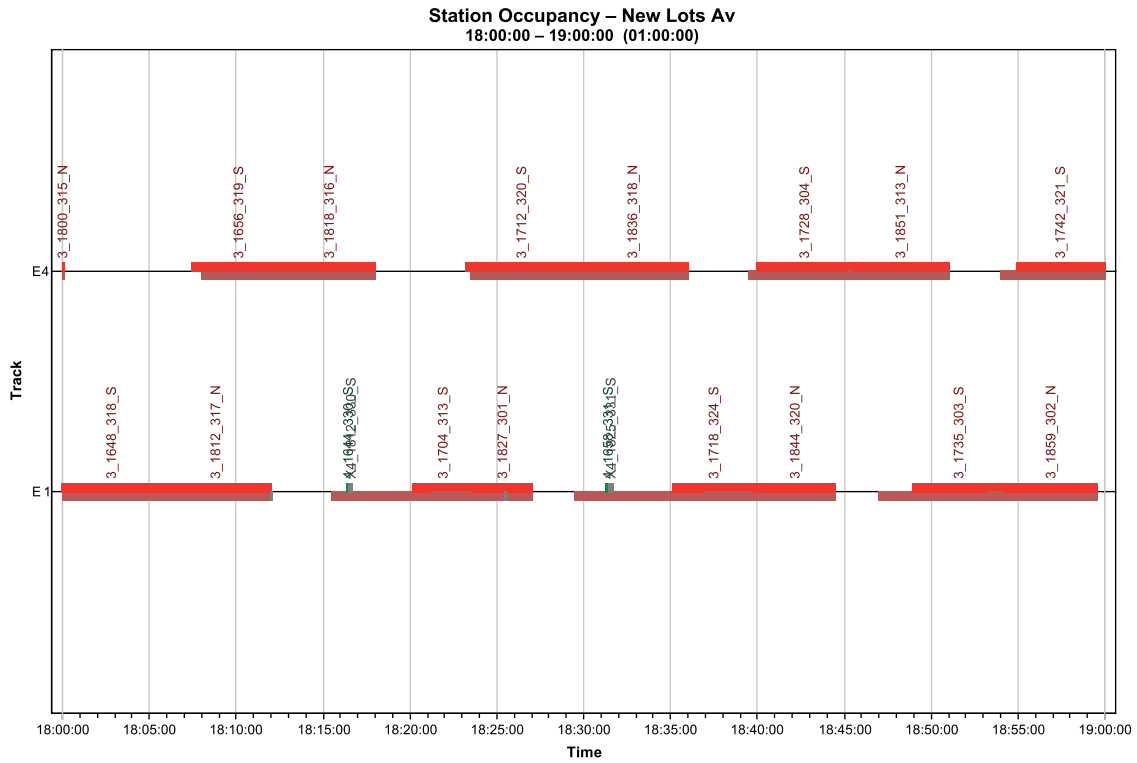


Figure F.4-7: Station Occupancy Chart - New Lots Avenue - 5:00 to 6:00 p.m.



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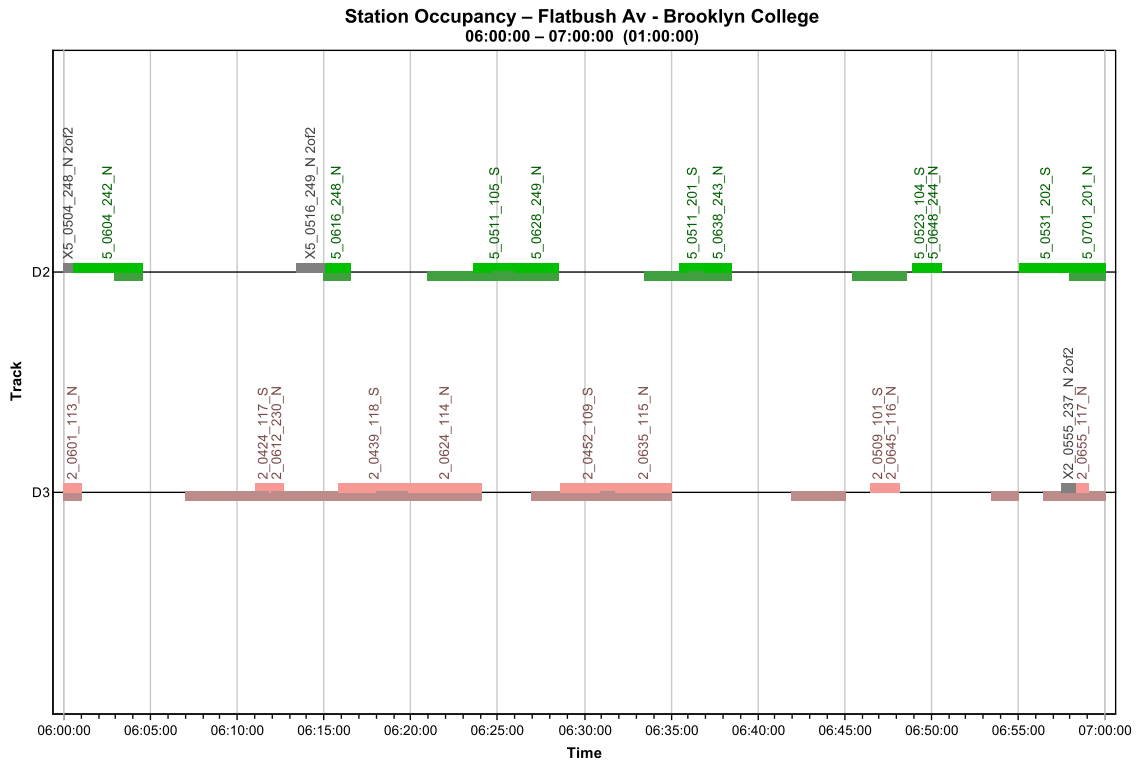
Figure F.4-8: Station Occupancy Chart - New Lots Avenue - 6:00 to 7:00 p.m.



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F.4.2 Flatbush Avenue/Brooklyn College

Figure F.4-9: Station Occupancy Chart - Flatbush Avenue /Brooklyn College - 6:00 to 7:00 a.m.



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Figure F.4-10: Station Occupancy Chart - Flatbush Avenue /Brooklyn College - 7:00 to 8:00 a.m.

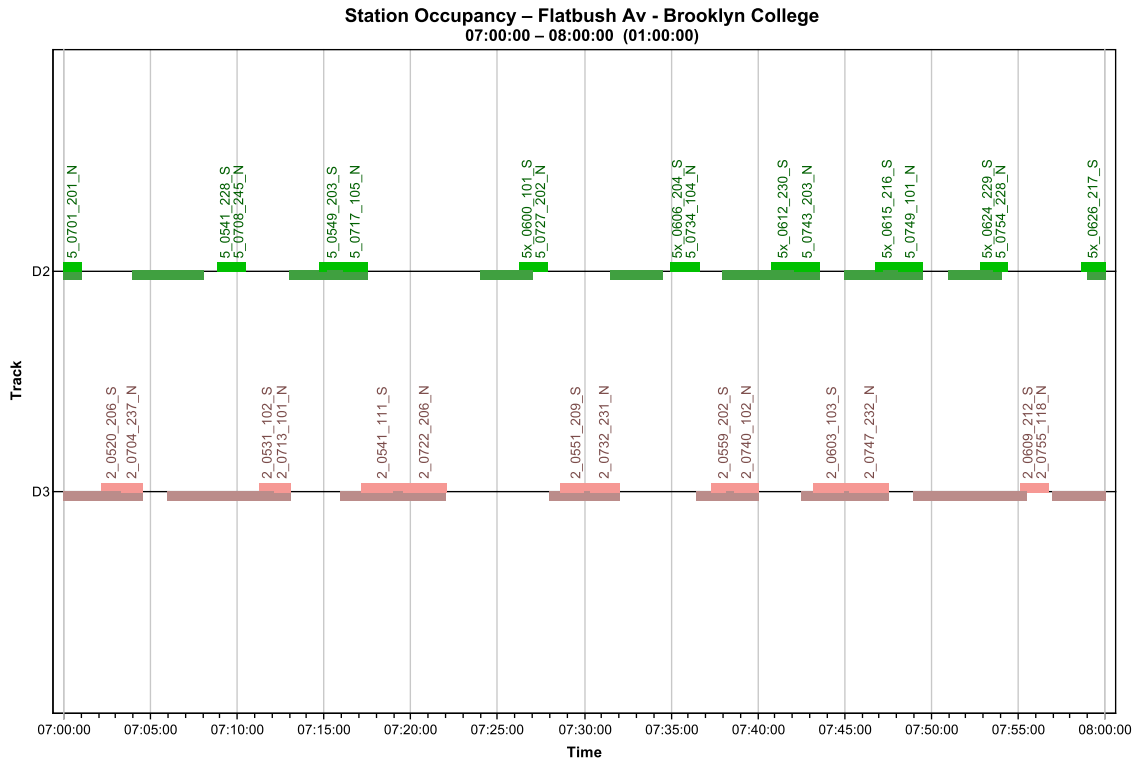
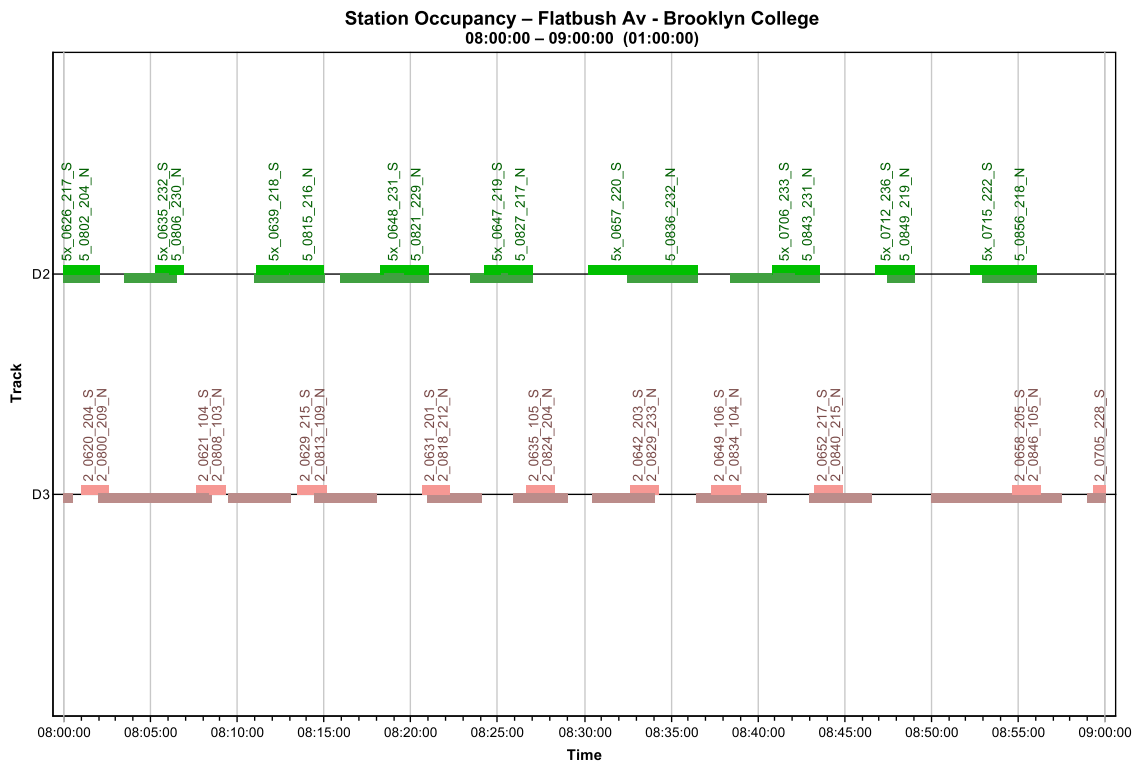


Figure F.4-11: Station Occupancy Chart - Flatbush Avenue/Brooklyn College - 8:00 to 9:00 a.m.



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Figure F.4-12: Station Occupancy Chart - Flatbush Avenue/Brooklyn College - 9:00 to 10:00 a.m.

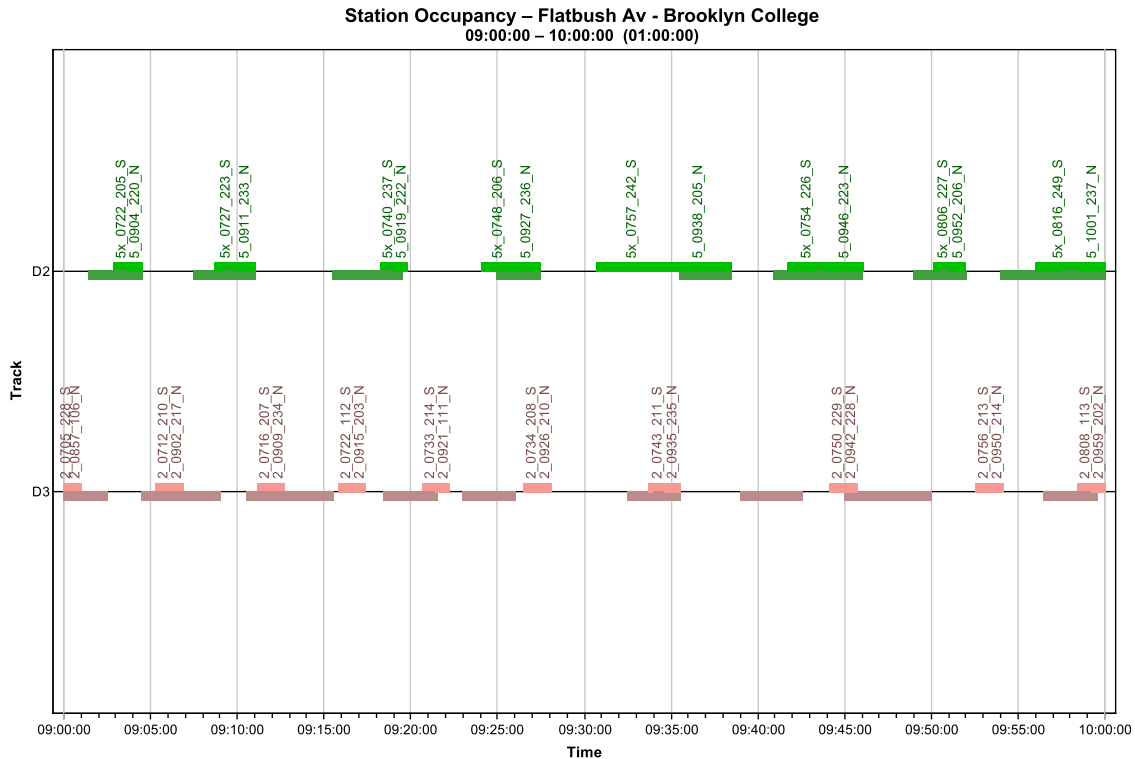
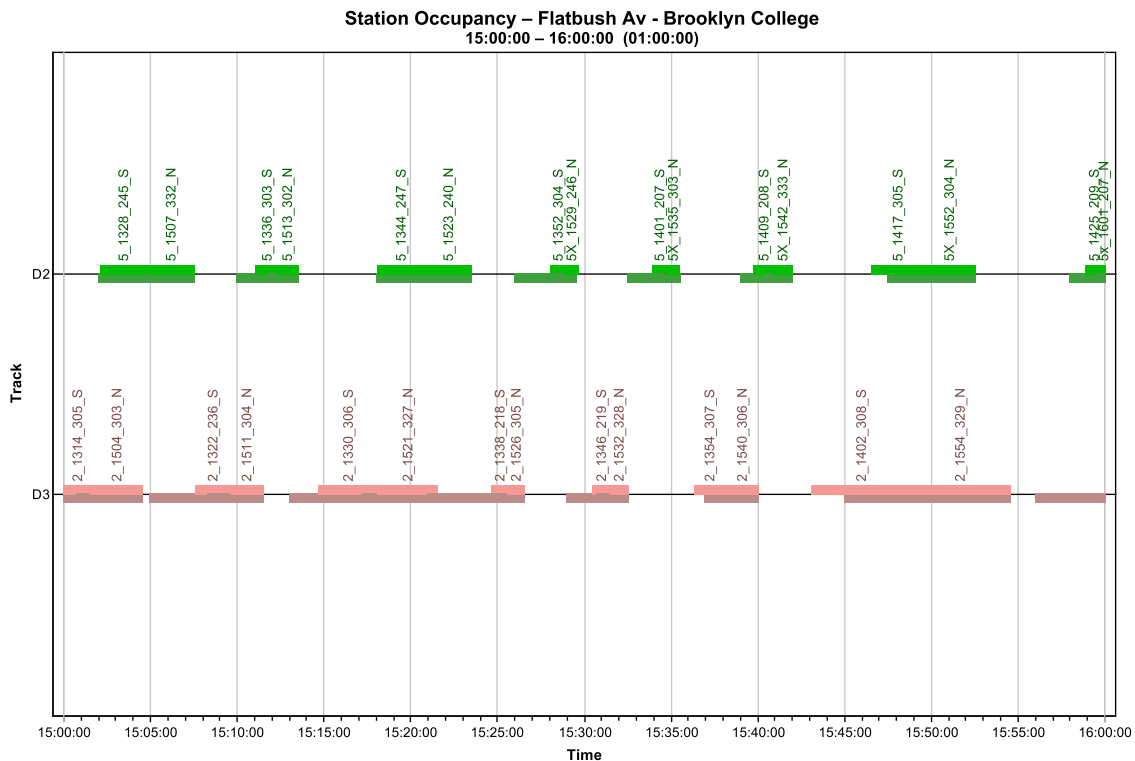


Figure F.4-13: Station Occupancy Chart - Flatbush Avenue/Brooklyn College - 3:00 to 4:00 p.m.



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Figure F.4-14: Station Occupancy Chart - Flatbush Avenue/Brooklyn College - 4:00 to 5:00 p.m.

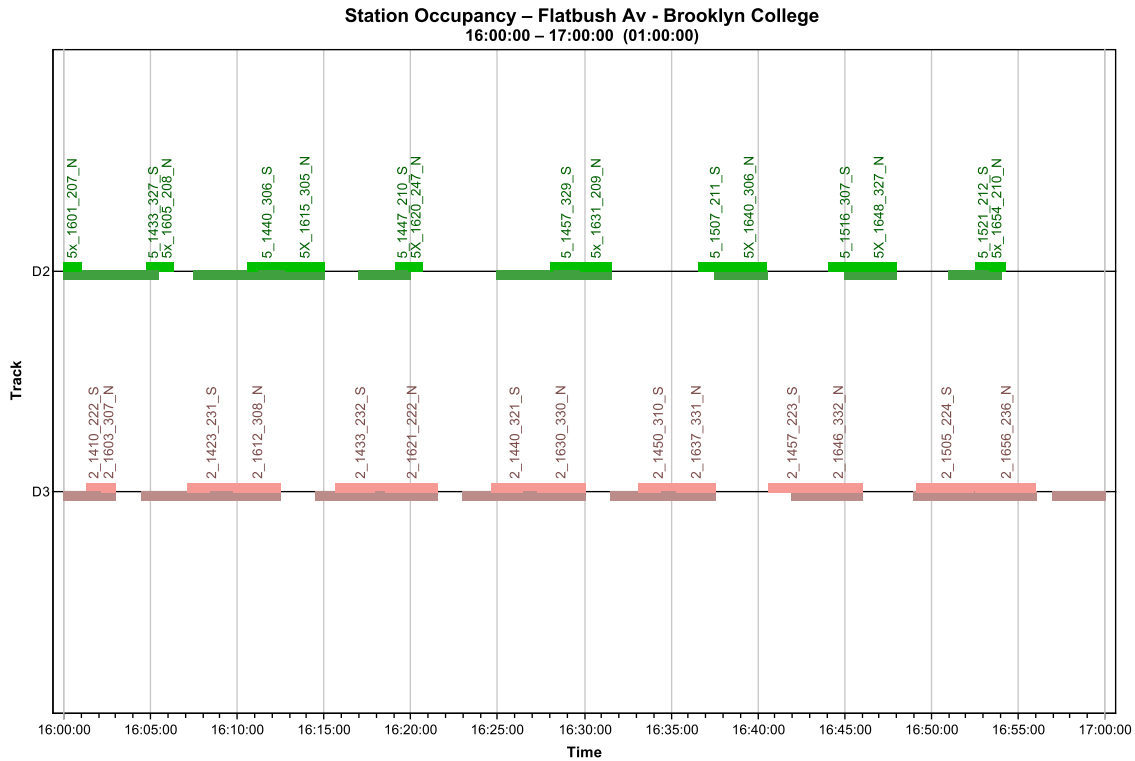
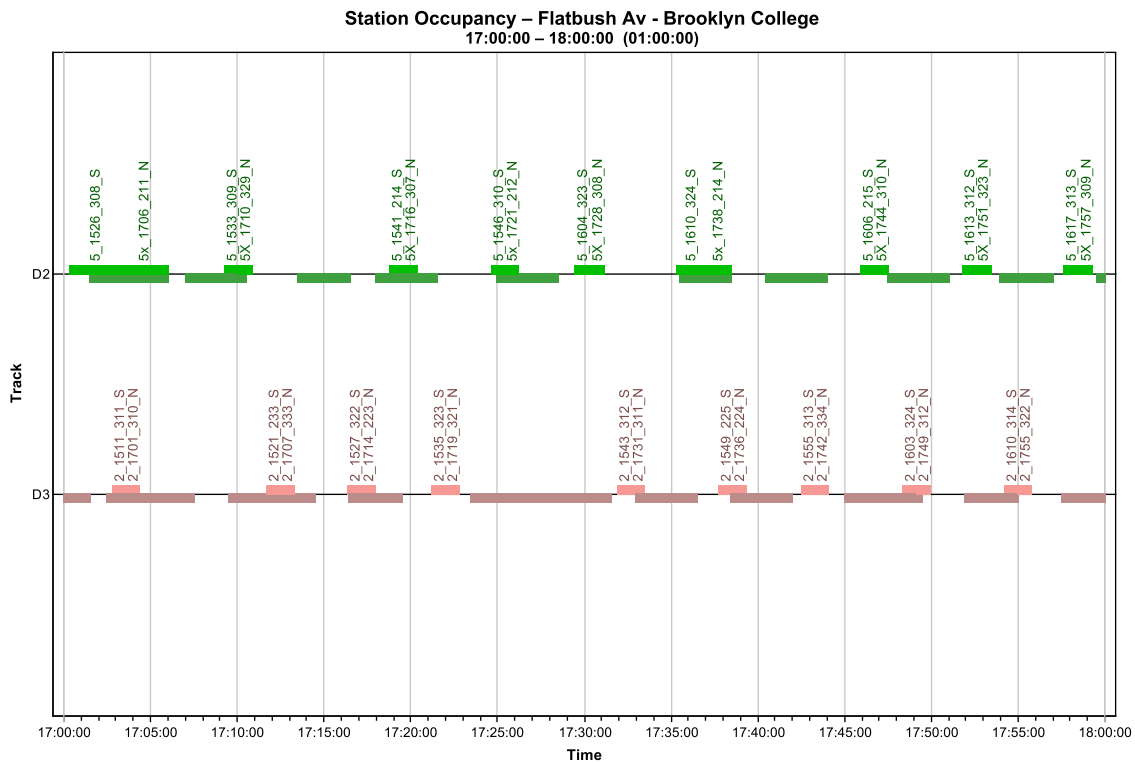
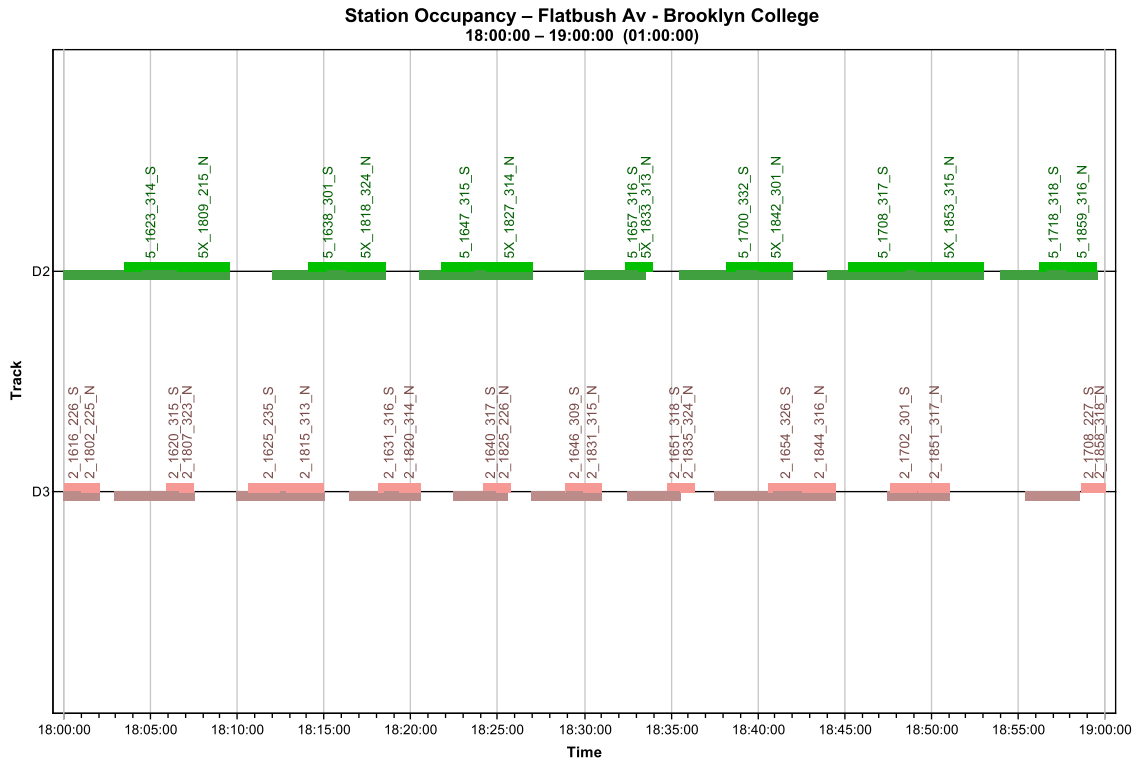


Figure F.4-15: Station Occupancy Chart - Flatbush Avenue/Brooklyn College - 5:00 to 6:00 pm.



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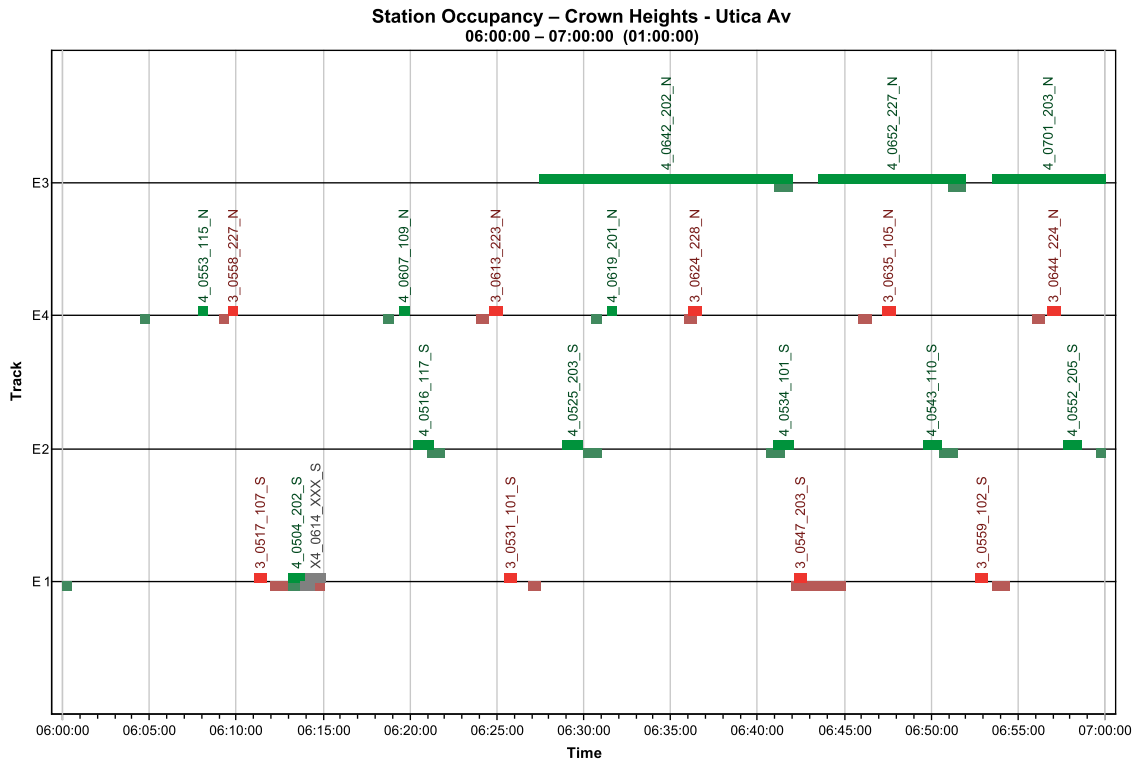
Figure F.4-16: Station Occupancy Chart - Flatbush Avenue/Brooklyn College - 6:00 to 7:00 p.m.



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F.4.3 Crown Heights - Utica Avenue

Figure F.4-17: Station Occupancy Chart - Crown Heights/Utica Avenue - 6:00 to 7:00 a.m.



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Figure F.4-18: Station Occupancy Chart - Crown Heights/Utica Avenue - 7:00 to 8:00 a.m.

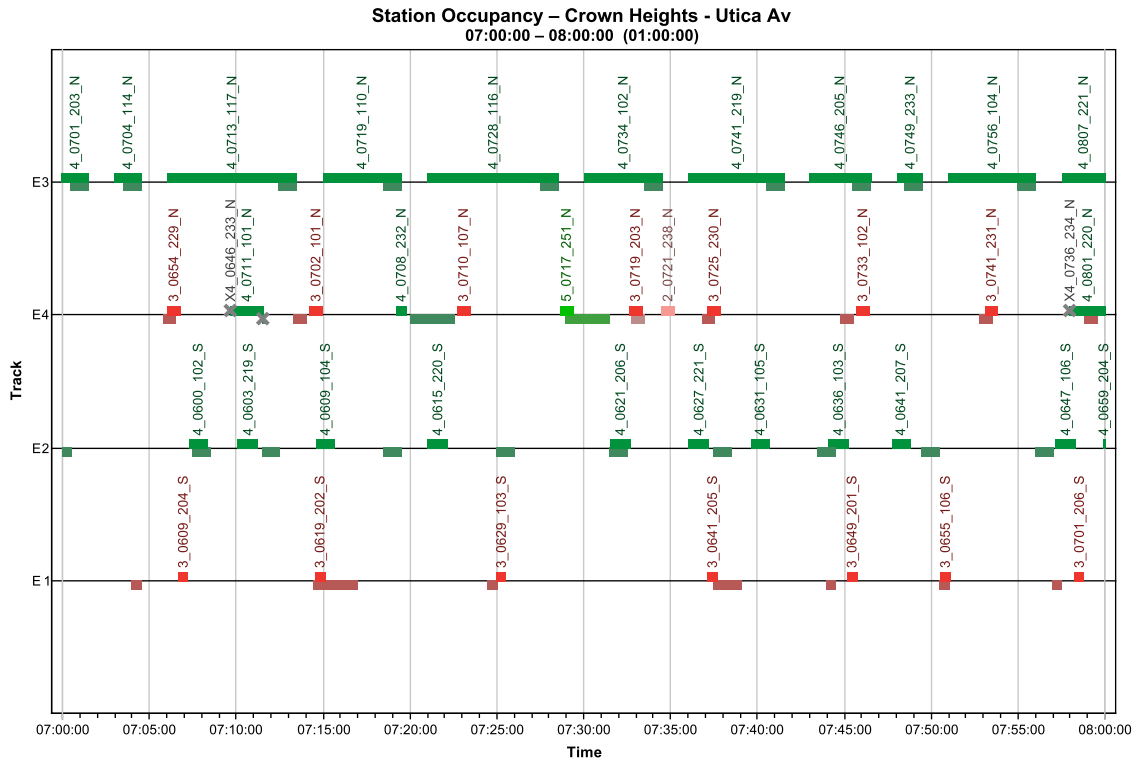
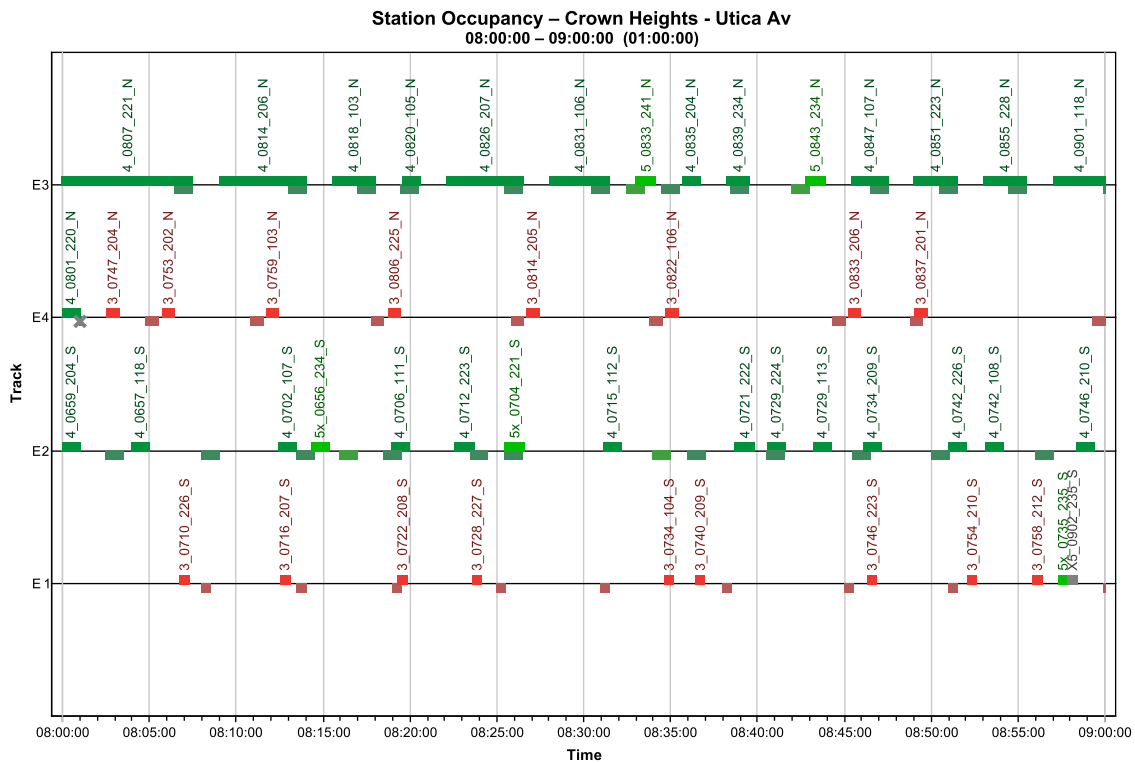


Figure F.4-19: Station Occupancy Chart - Crown Heights/Utica Avenue - 8:00 to 9:00 a.m.



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Figure F.4-20: Station Occupancy Chart - Crown Heights/Utica Avenue - 9:00 to 10:00 a.m.

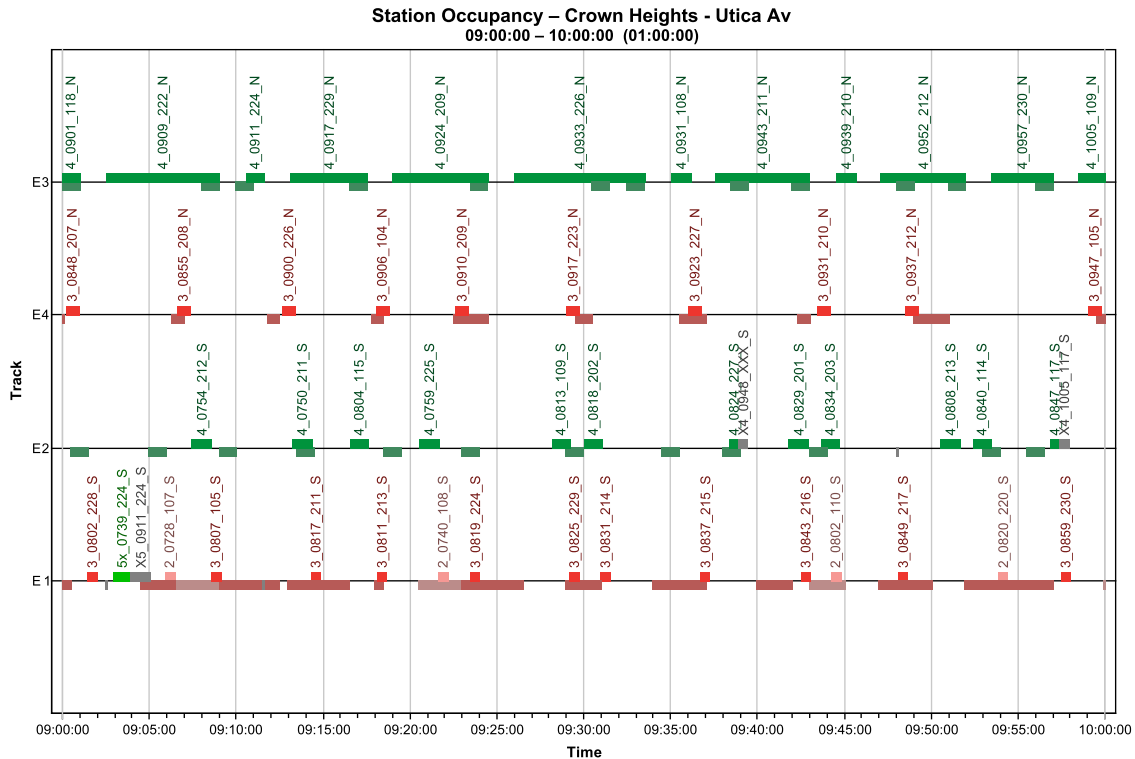
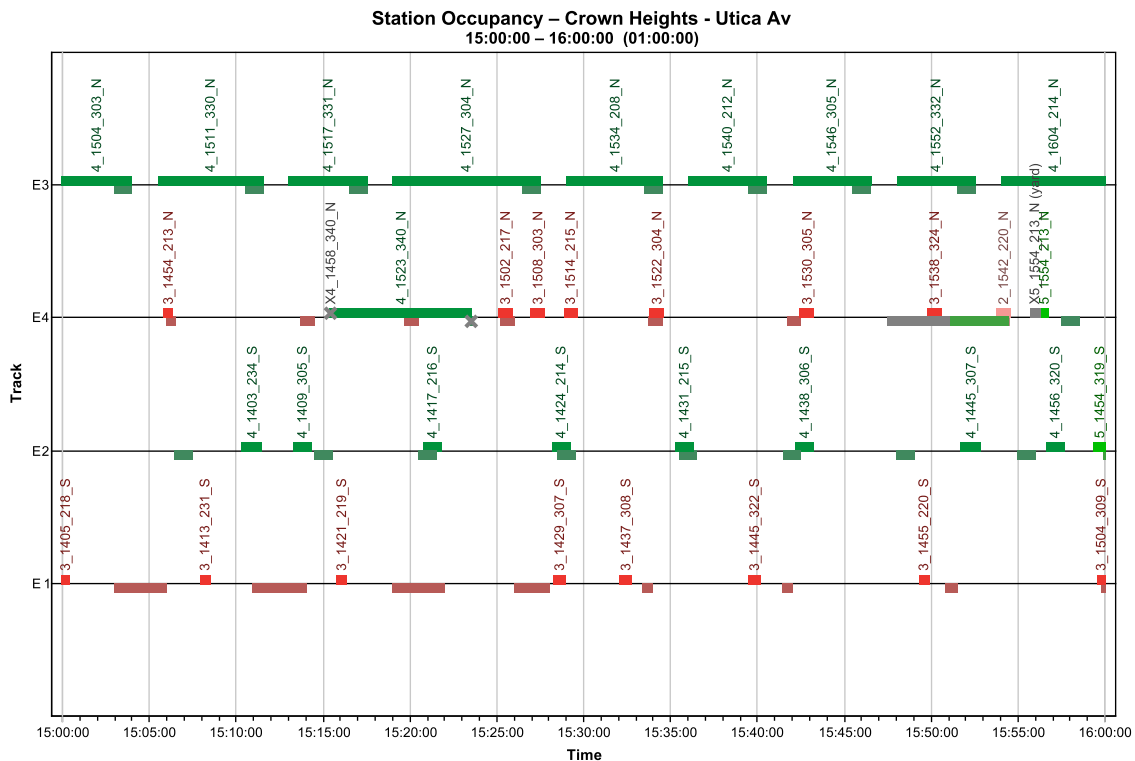


Figure F.4-21: Station Occupancy Chart - Crown Heights/Utica Avenue - 3:00 to 4:00 p.m.



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Figure F.4-22: Station Occupancy Chart - Crown Heights/Utica Avenue - 4:00 to 5:00 p.m.

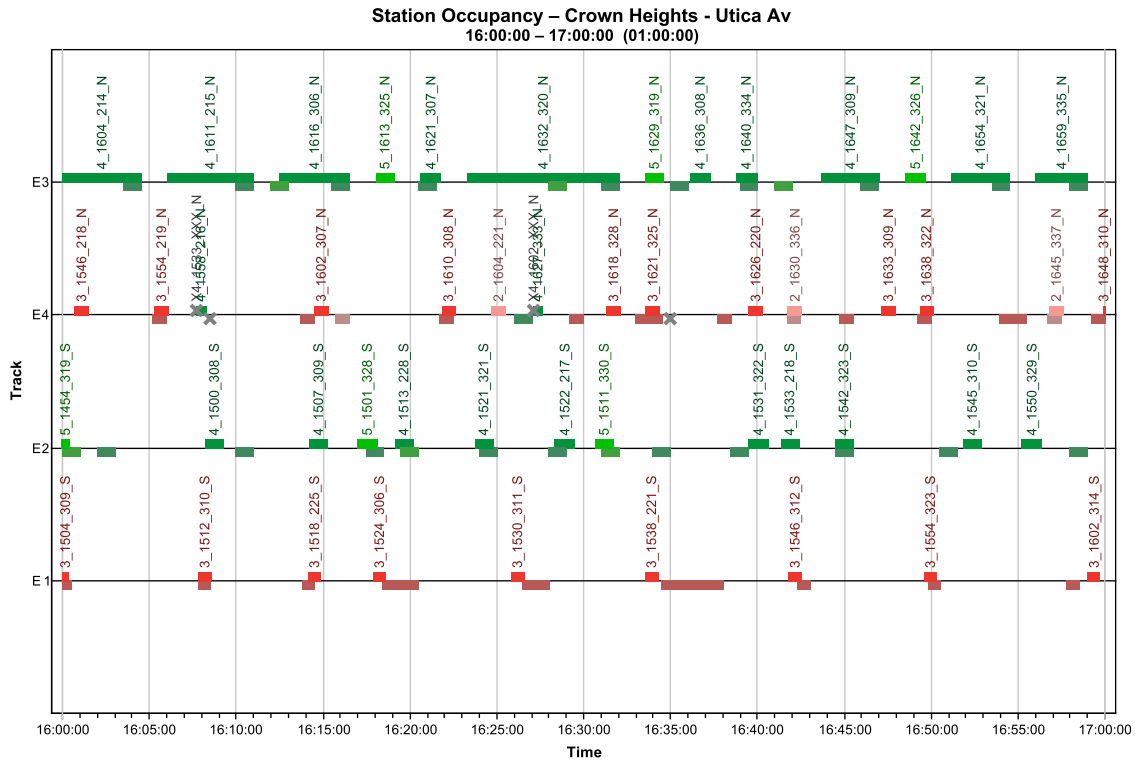
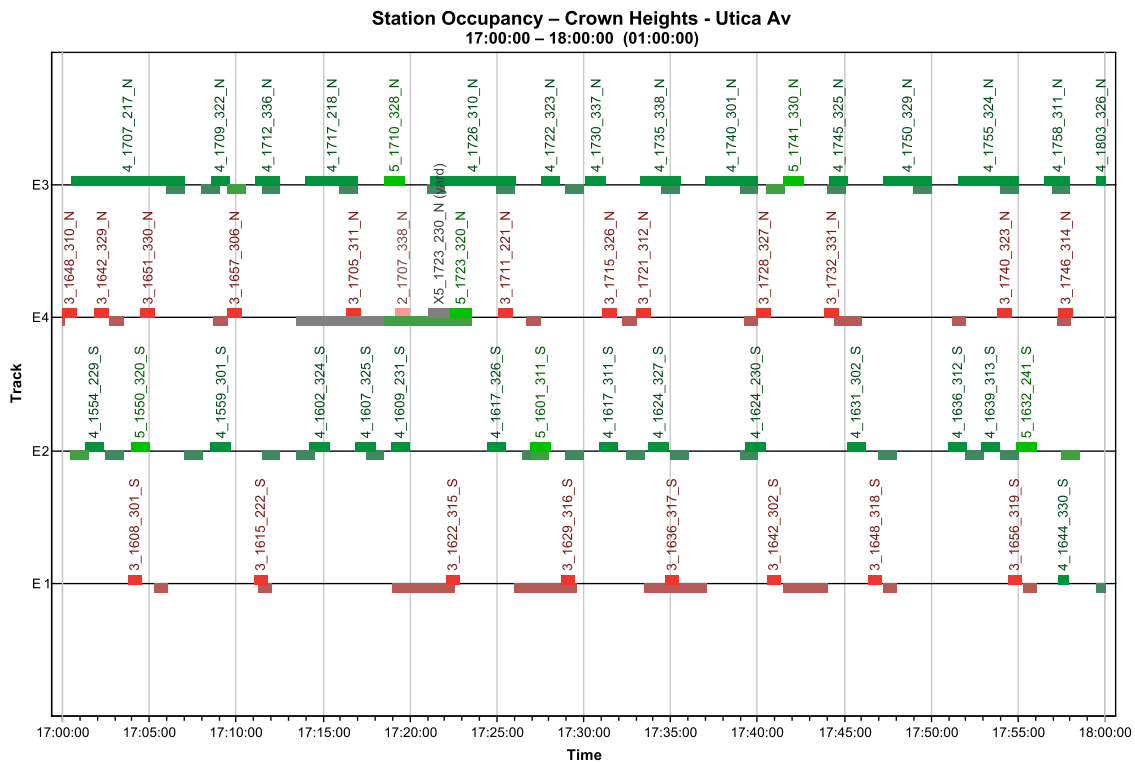
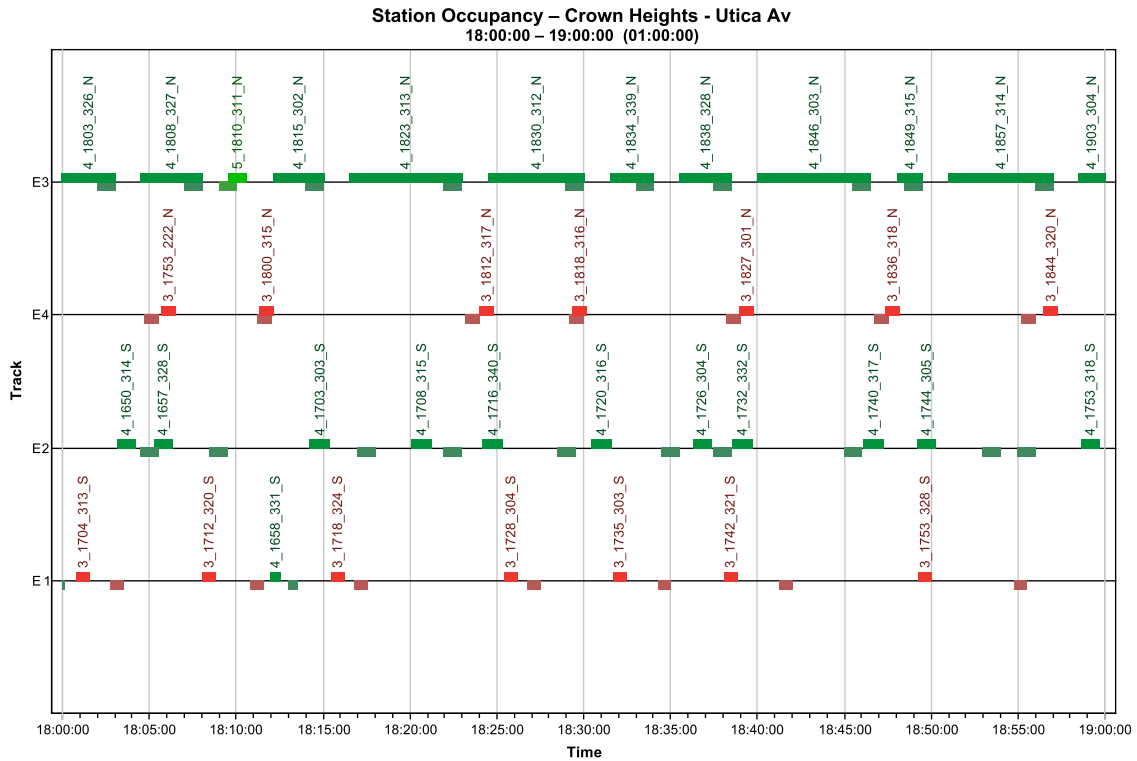


Figure F.4-23: Station Occupancy Chart - Crown Heights/Utica Avenue - 5:00 to 6:00 p.m.



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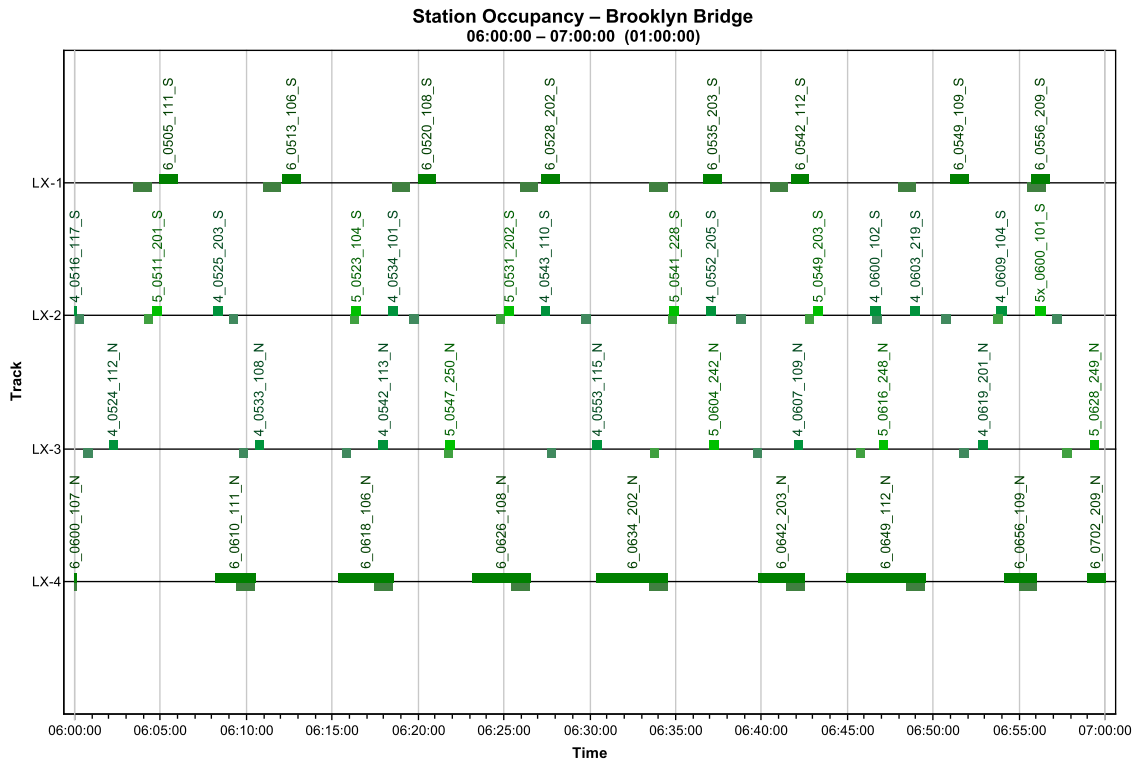
Figure F.4-24: Station Occupancy Chart - Crown Heights/Utica Avenue - 6:00 to 7:00 p.m.



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F.4.4 Brooklyn Bridge

Figure F.4-25: Station Occupancy Chart - Brooklyn Bridge - 6:00 to 7:00 a.m.



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Figure F.4-26: Station Occupancy Chart - Brooklyn Bridge - 7:00 to 8:00 a.m.

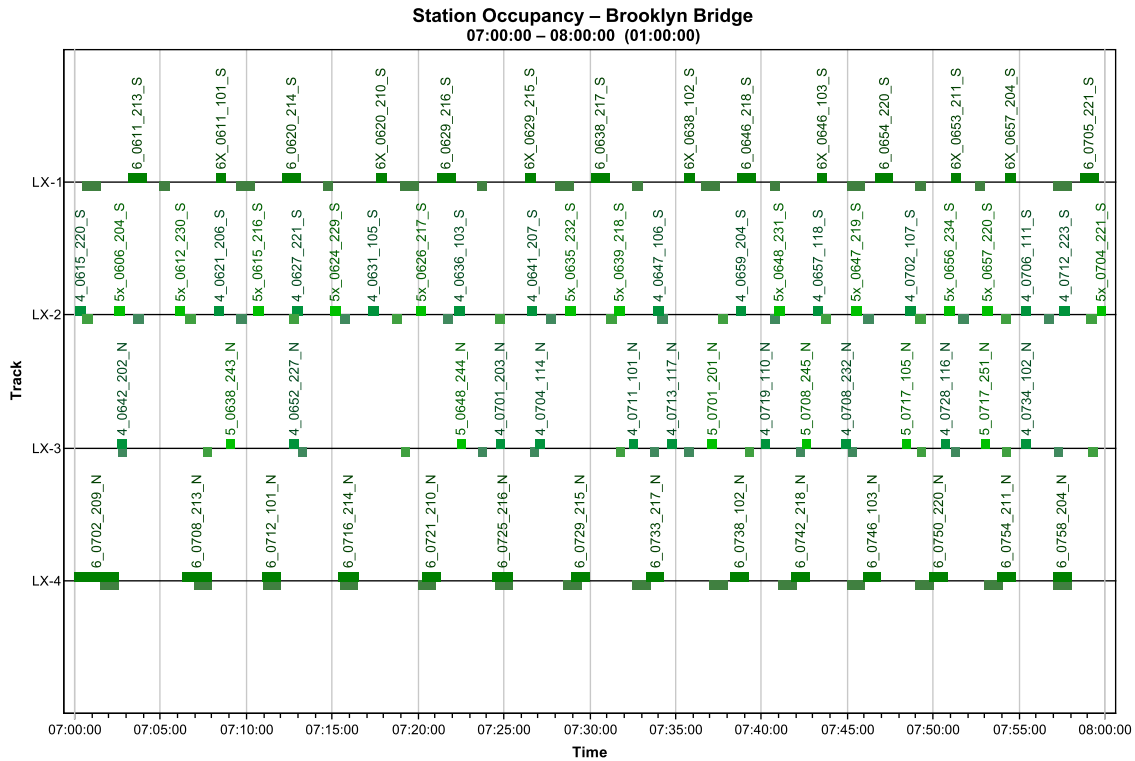
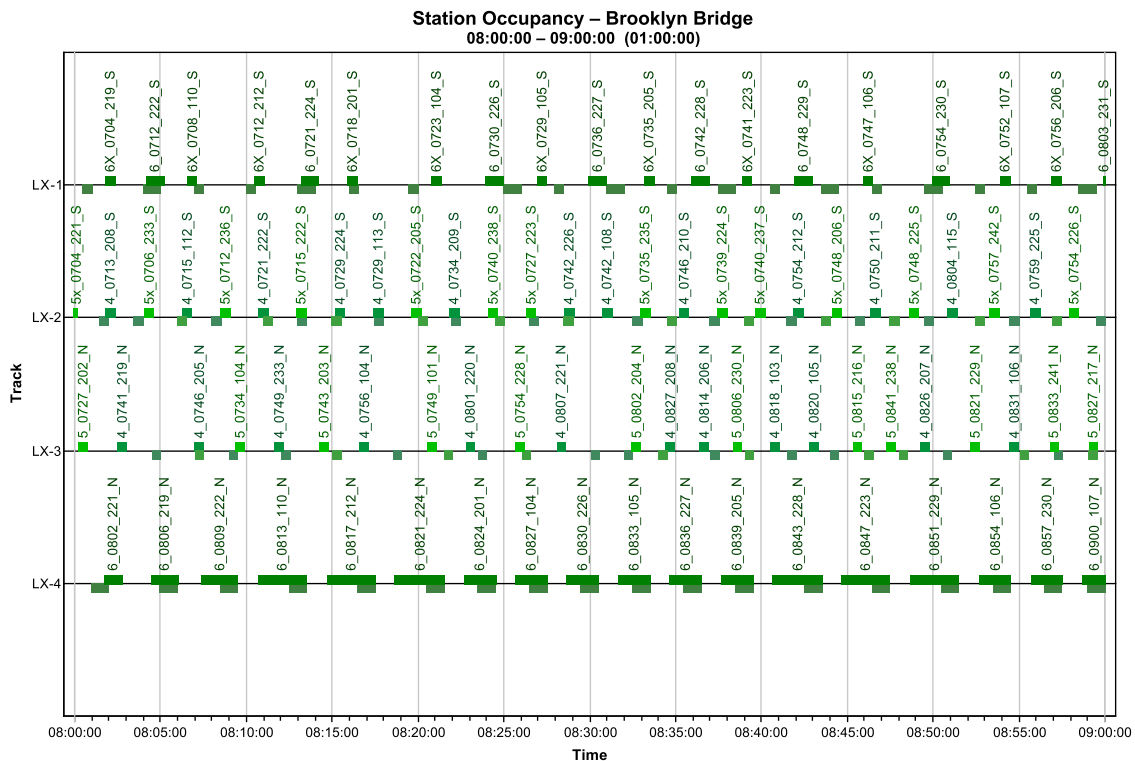


Figure F.4-27: Station Occupancy Chart - Brooklyn Bridge - 8:00 to 9:00 a.m.



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Figure F.4-28: Station Occupancy Chart - Brooklyn Bridge - 9:00 to 10:00 a.m.

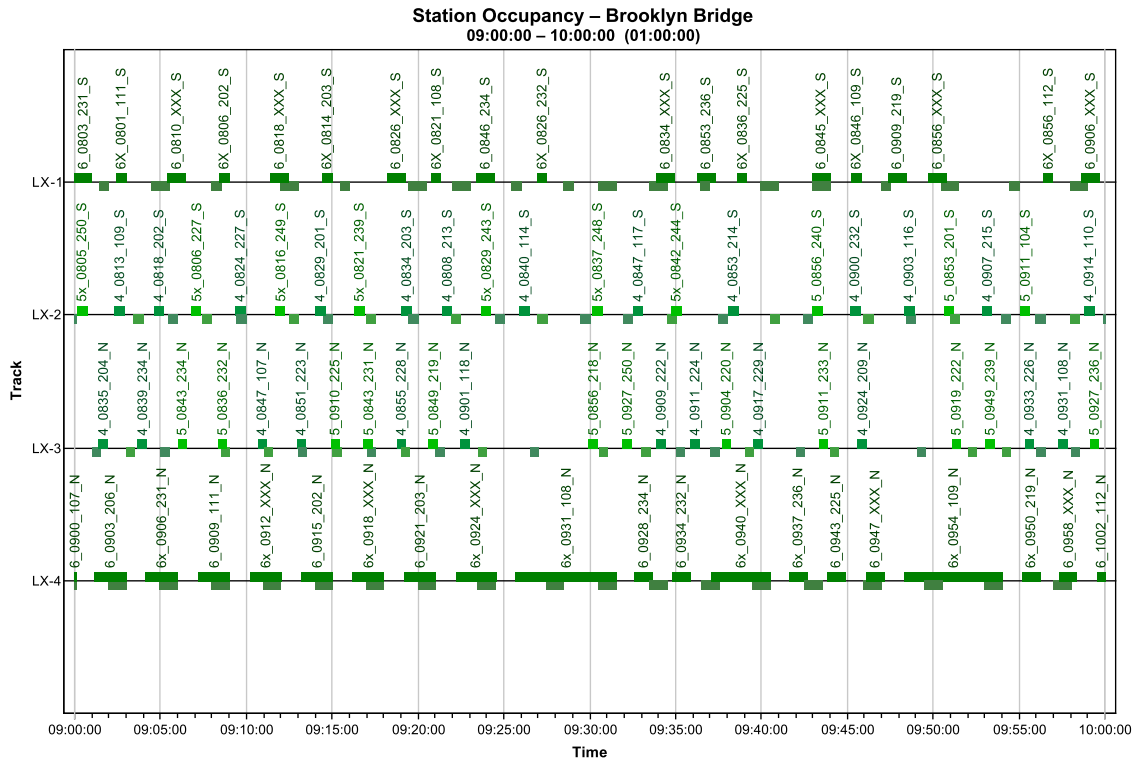
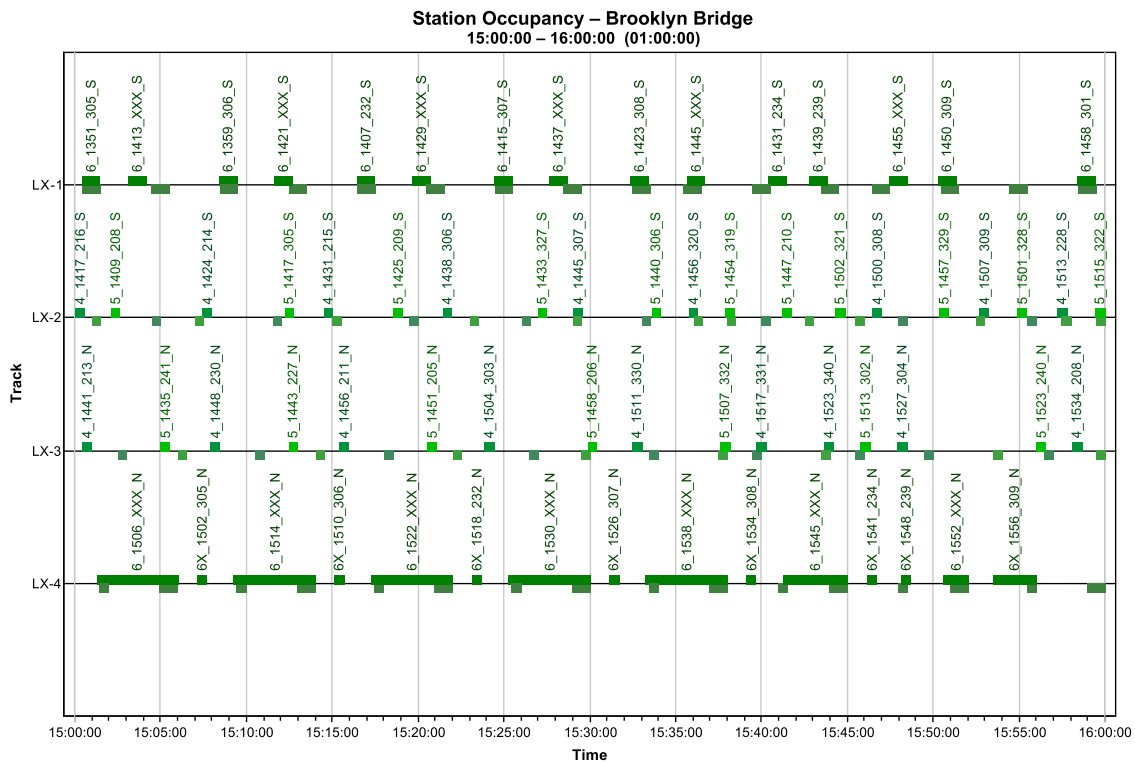


Figure F.4-29: Station Occupancy Chart - Brooklyn Bridge - 3:00 to 4:00 p.m.



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Figure F.4-30: Station Occupancy Chart - Brooklyn Bridge - 4:00 to 5:00 p.m.

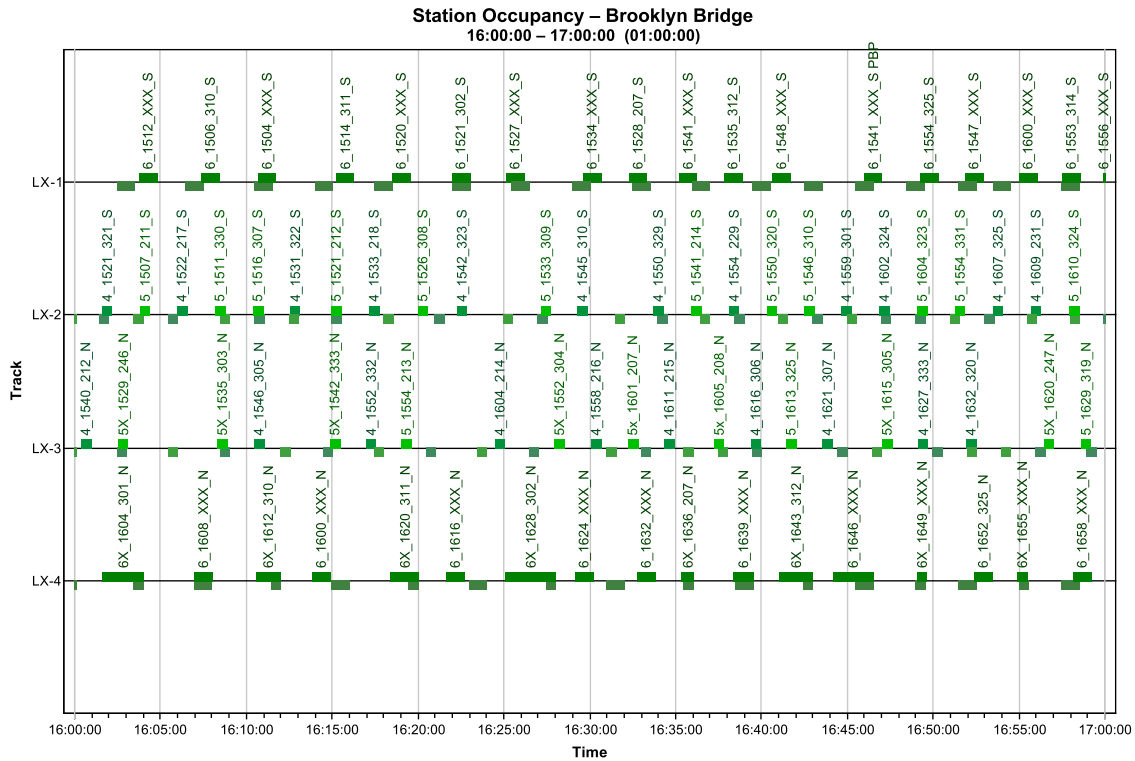
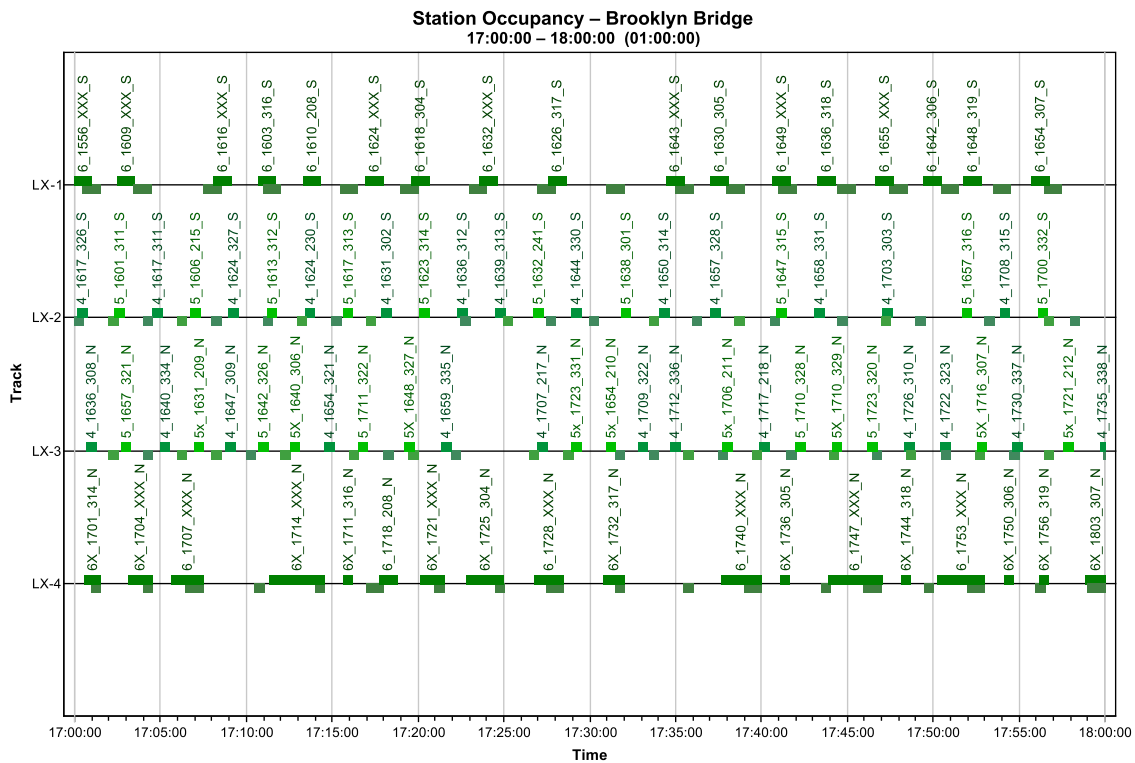
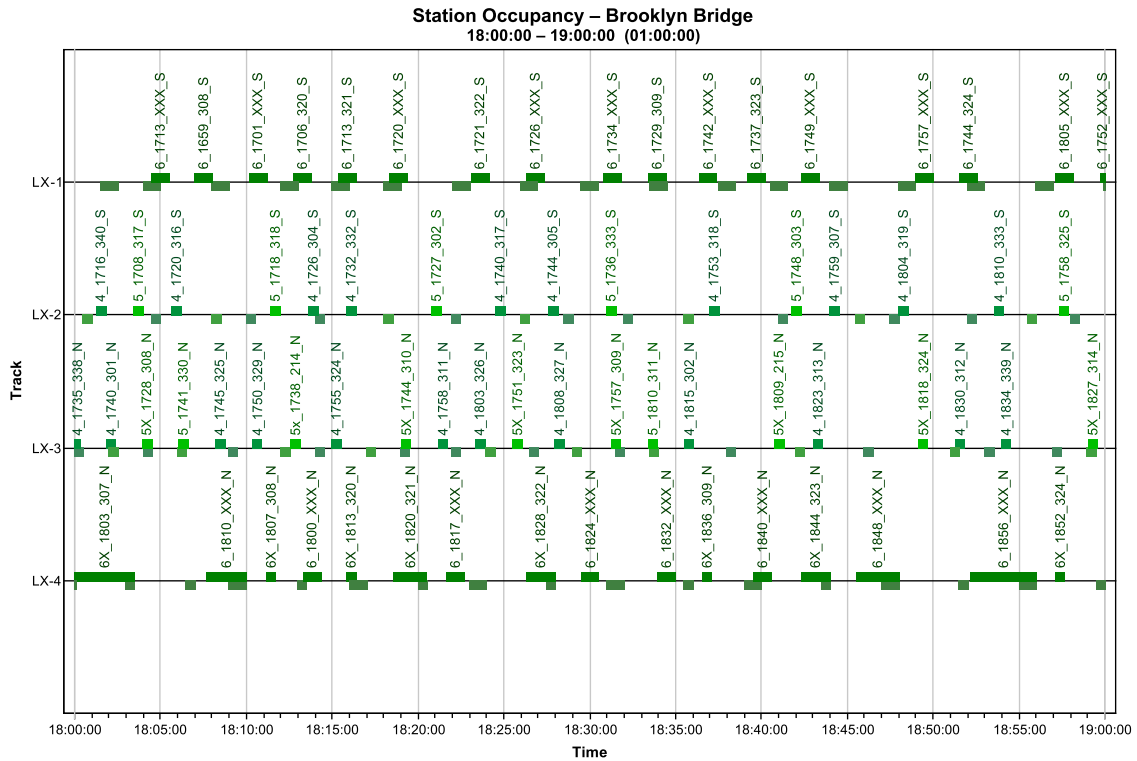


Figure F.4-31: Station Occupancy Chart - Brooklyn Bridge - 5:00 to 6:00 p.m.



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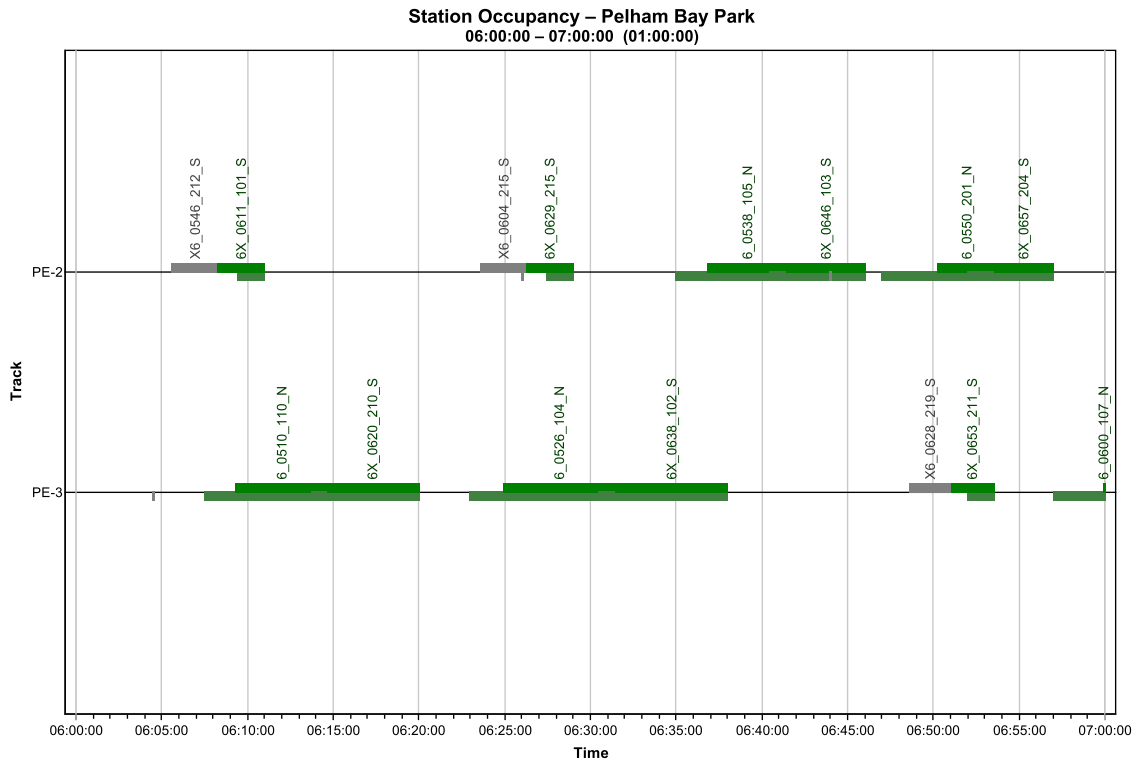
Figure F.4-32: Station Occupancy Chart - Brooklyn Bridge - 6:00 to 7:00 p.m.



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F.4.5 Pelham Bay Park

Figure F.4-33: Station Occupancy Chart – Pelham Bay Park – 6:00 to 7:00 a.m.



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Figure F.4-34: Station Occupancy Chart – Pelham Bay Park – 7:00 to 8:00 a.m.

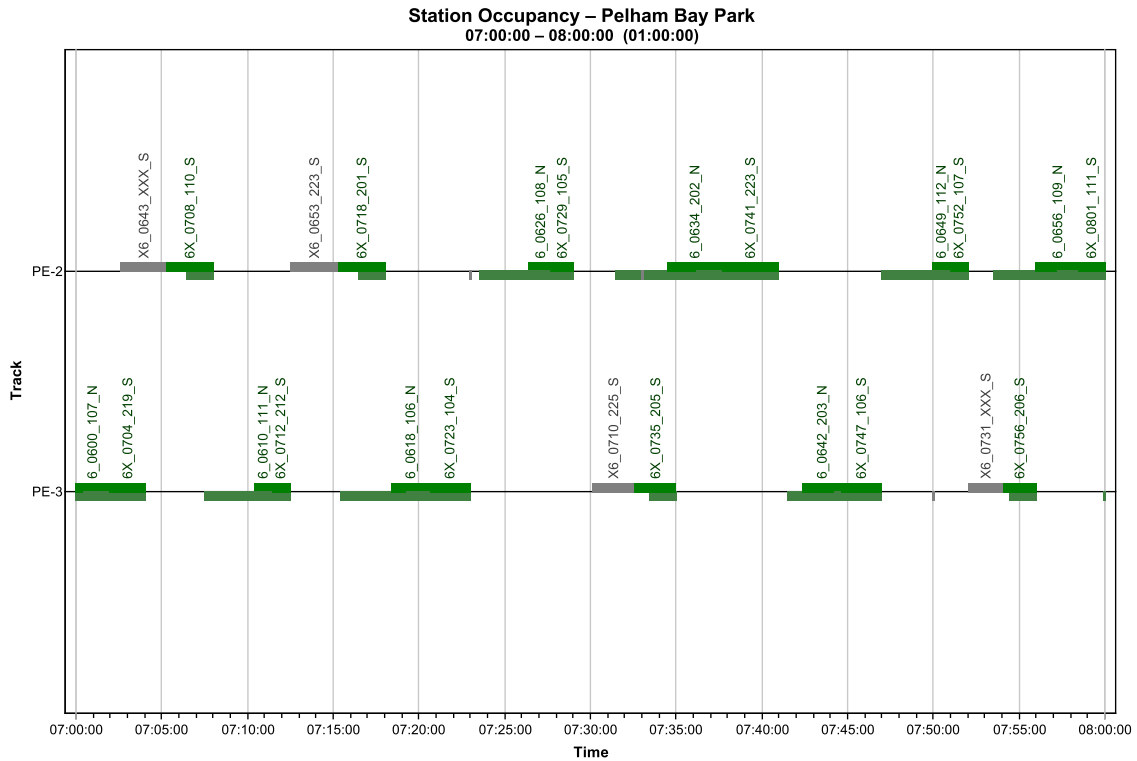
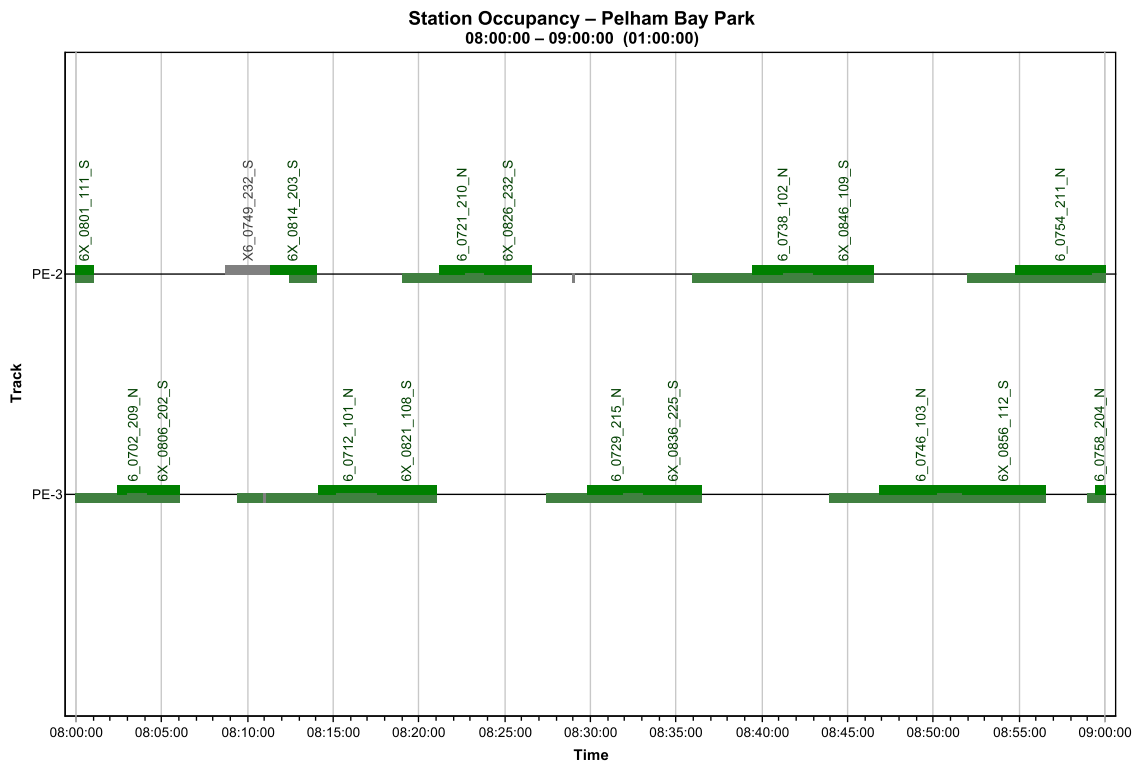


Figure F.4-35: Station Occupancy Chart – Pelham Bay Park – 8:00 to 9:00 a.m.



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Figure F.4-36: Station Occupancy Chart – Pelham Bay Park – 9:00 to 10:00 a.m.

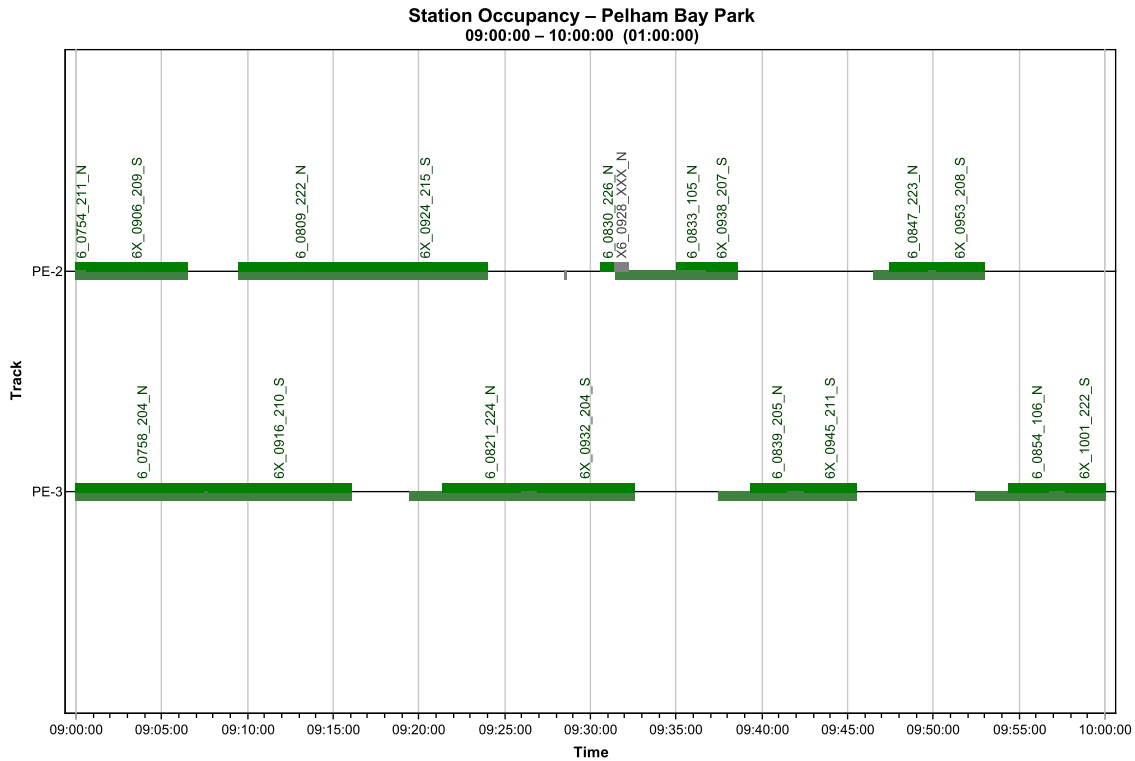
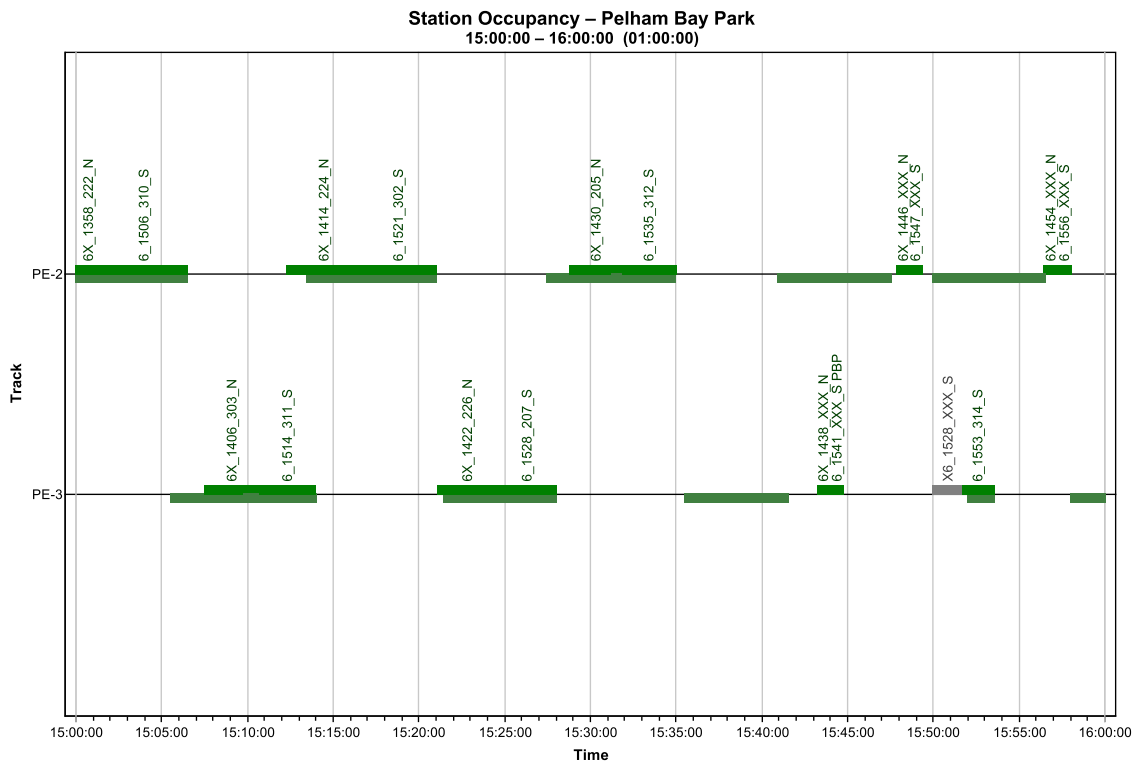


Figure F.4-37: Station Occupancy Chart – Pelham Bay Park – 3:00 to 4:00 p.m.



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Figure F.4-38: Station Occupancy Chart – Pelham Bay Park – 4:00 to 5:00 p.m.

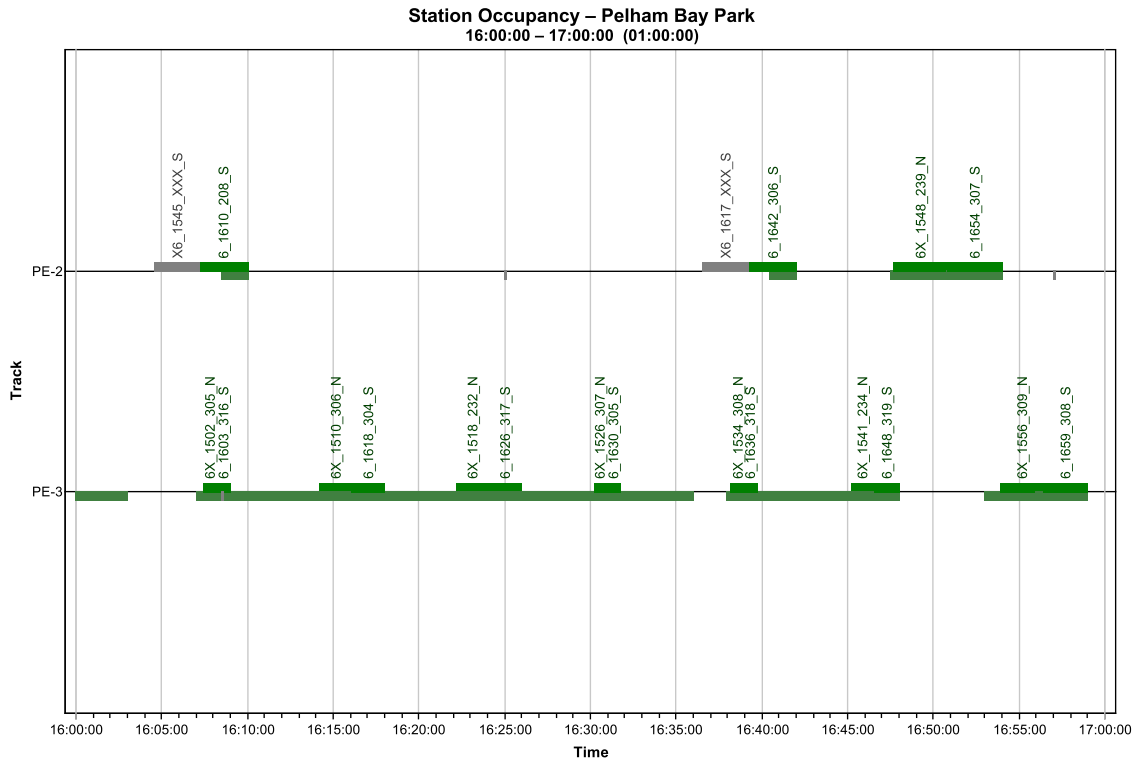
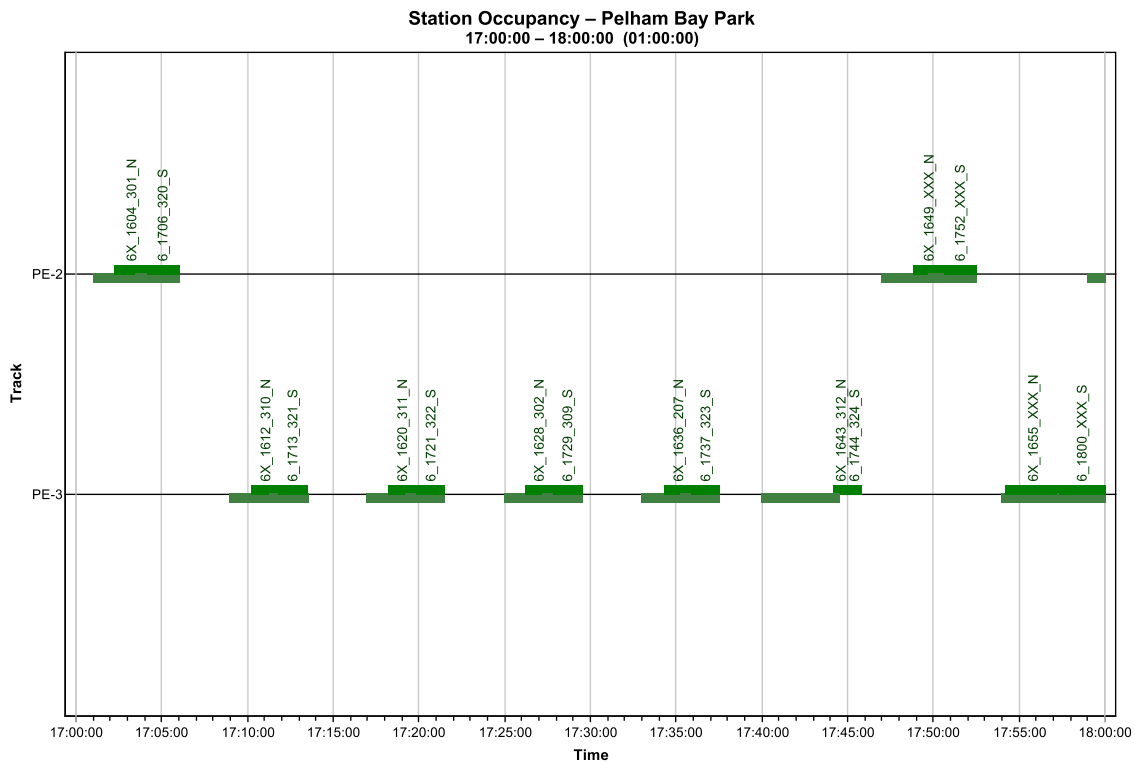
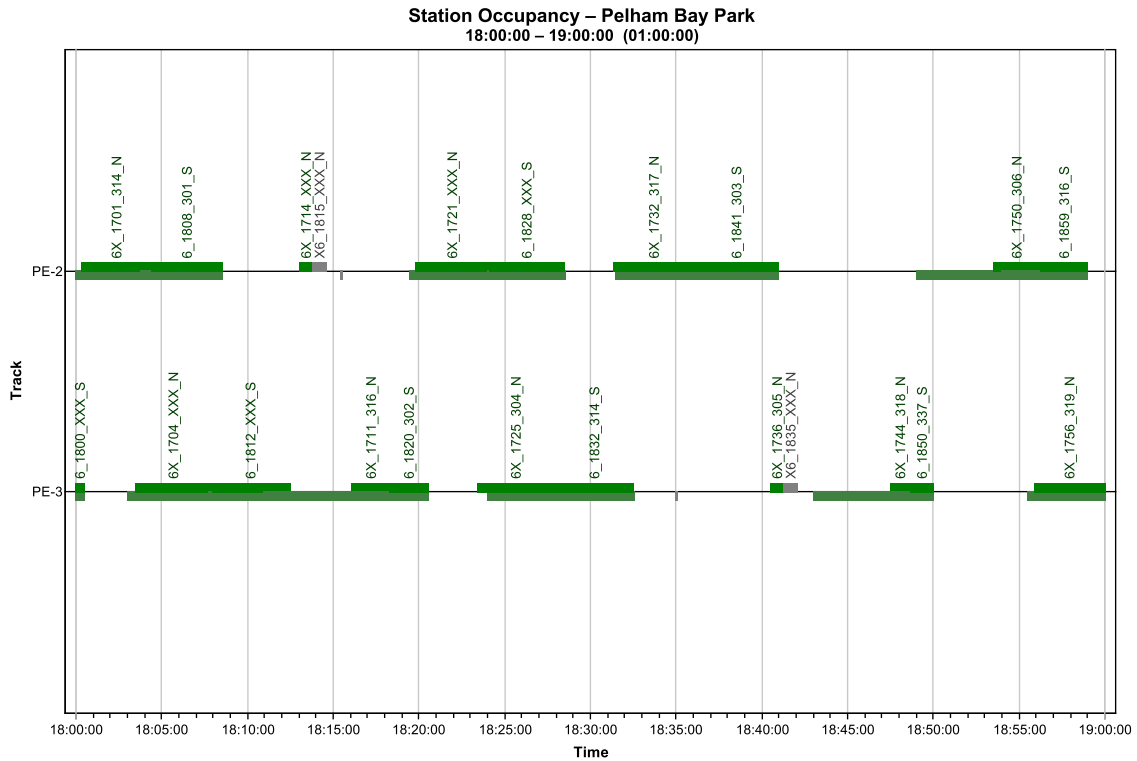


Figure F.4-39: Station Occupancy Chart – Pelham Bay Park – 5:00 to 6:00 p.m.



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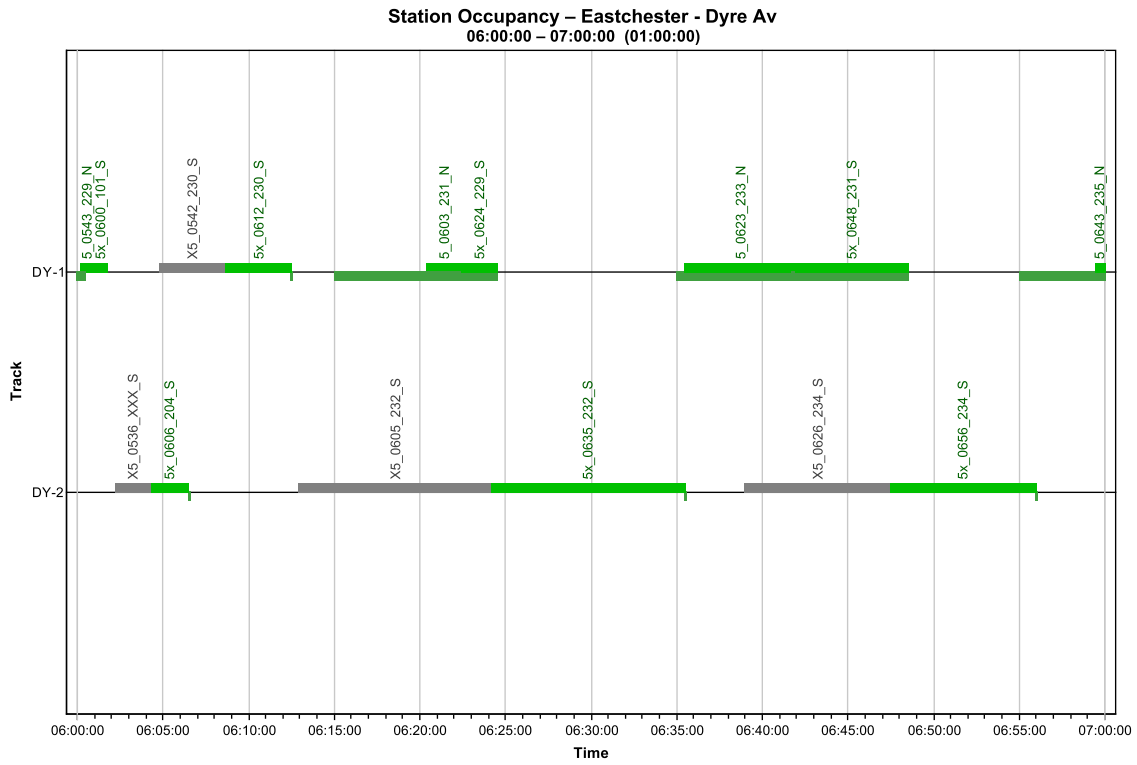
Figure F.4-40: Station Occupancy Chart – Pelham Bay Park – 6:00 to 7:00 p.m.



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F.4.6 Eastchester-Dyre Avenue

Figure F.4-41: Station Occupancy Chart – Eastchester-Dyre Avenue – 6:00 to 7:00 a.m.



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Figure F.4-42: Station Occupancy Chart – Eastchester-Dyre Avenue – 7:00 to 8:00 a.m.

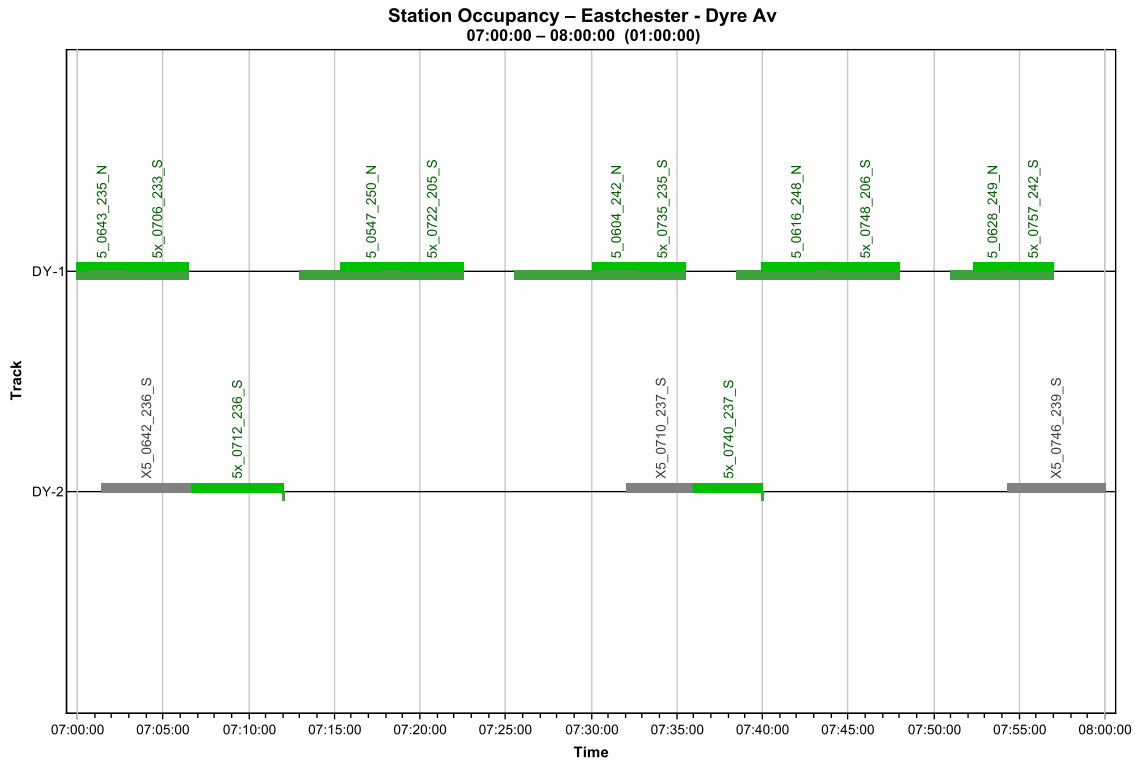
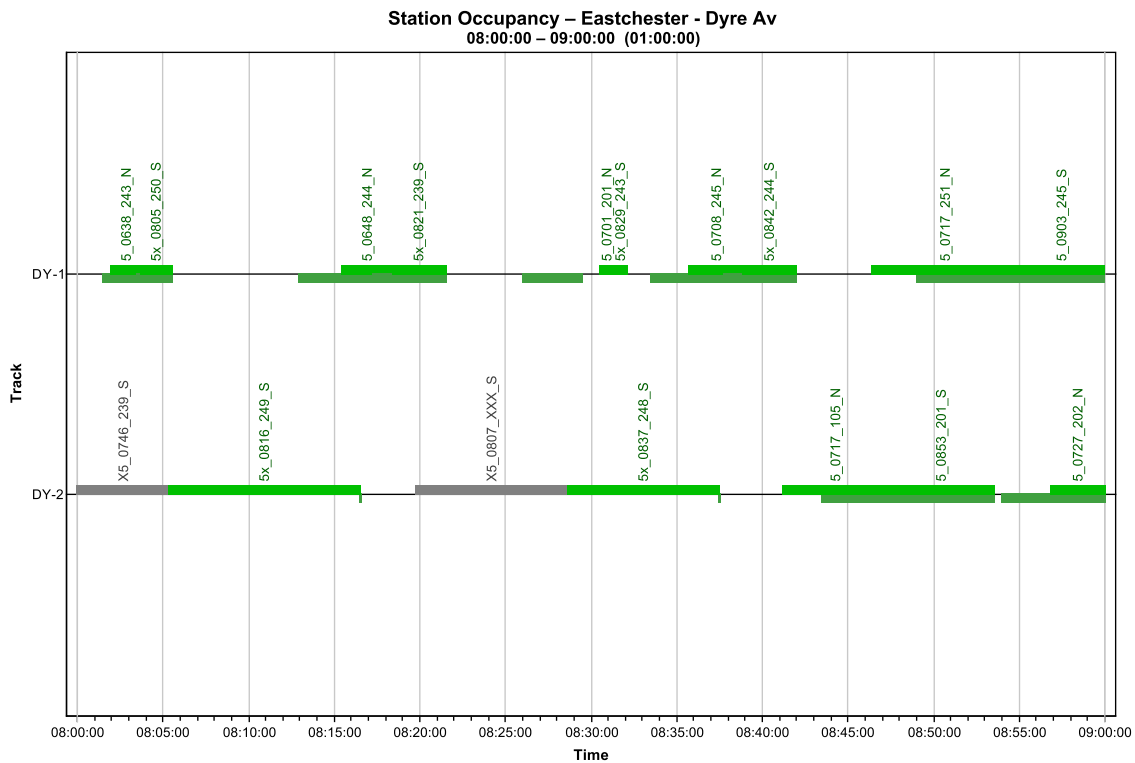


Figure F.4-43: Station Occupancy Chart – Eastchester-Dyre Avenue – 8:00 to 9:00 a.m.



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Figure F.4-44: Station Occupancy Chart – Eastchester-Dyre Avenue – 9:00 to 10:00 a.m.

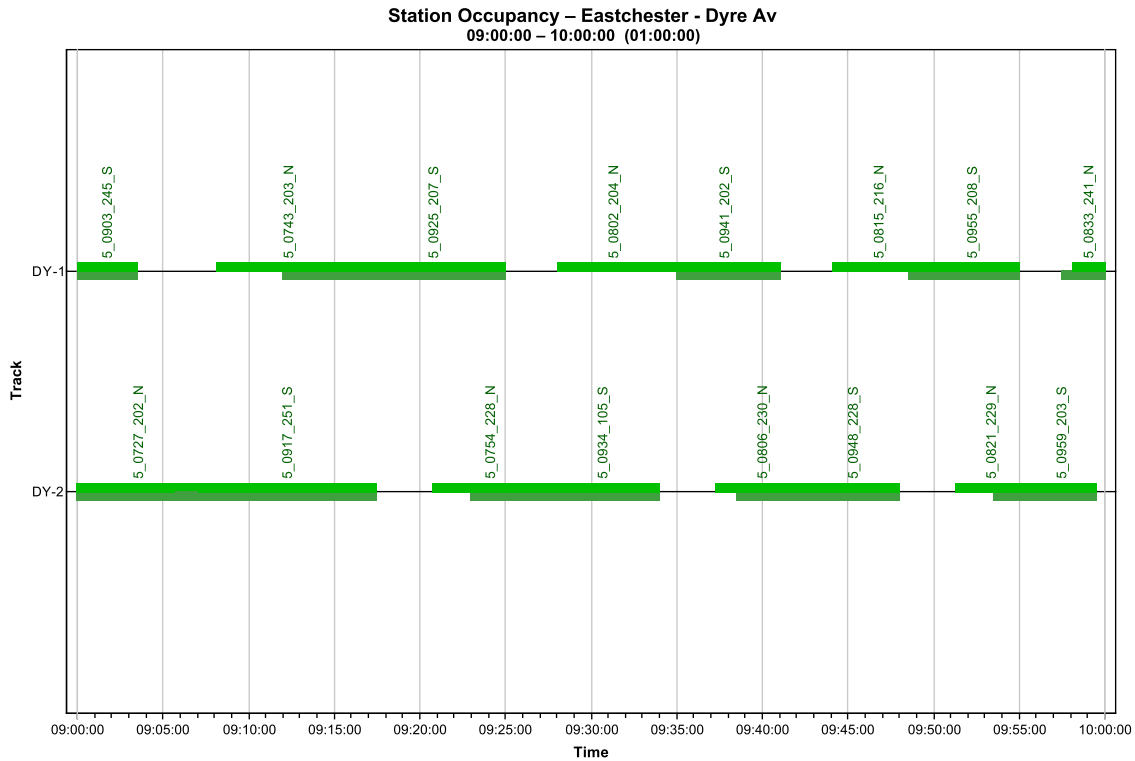
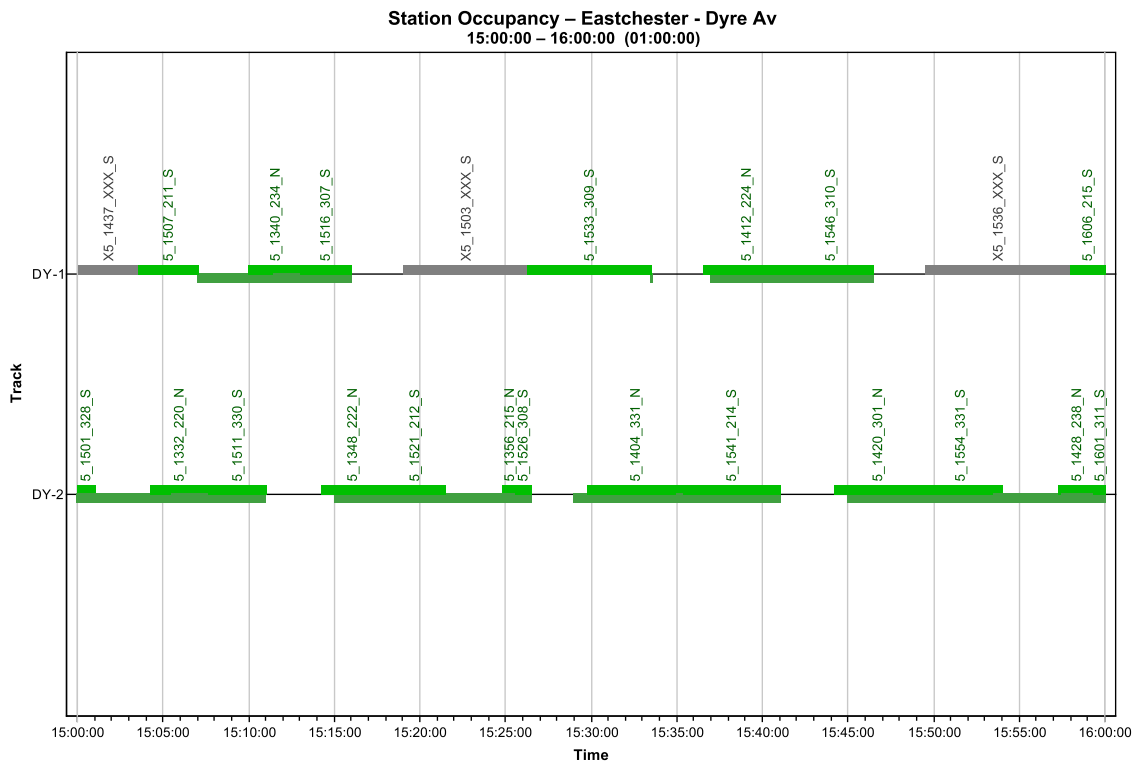


Figure F.4-45: Station Occupancy Chart – Eastchester-Dyre Avenue – 3:00 to 4:00 p.m.



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Figure F.4-46: Station Occupancy Chart – Eastchester-Dyre Avenue – 4:00 to 5:00 p.m.

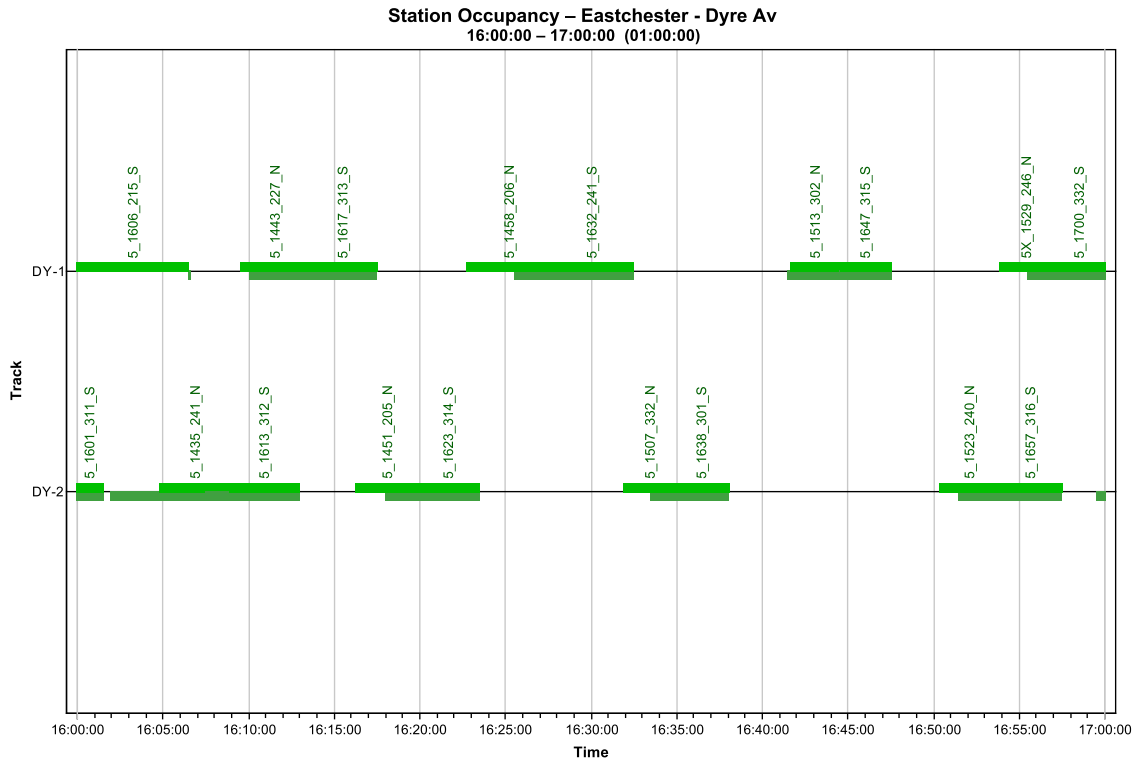
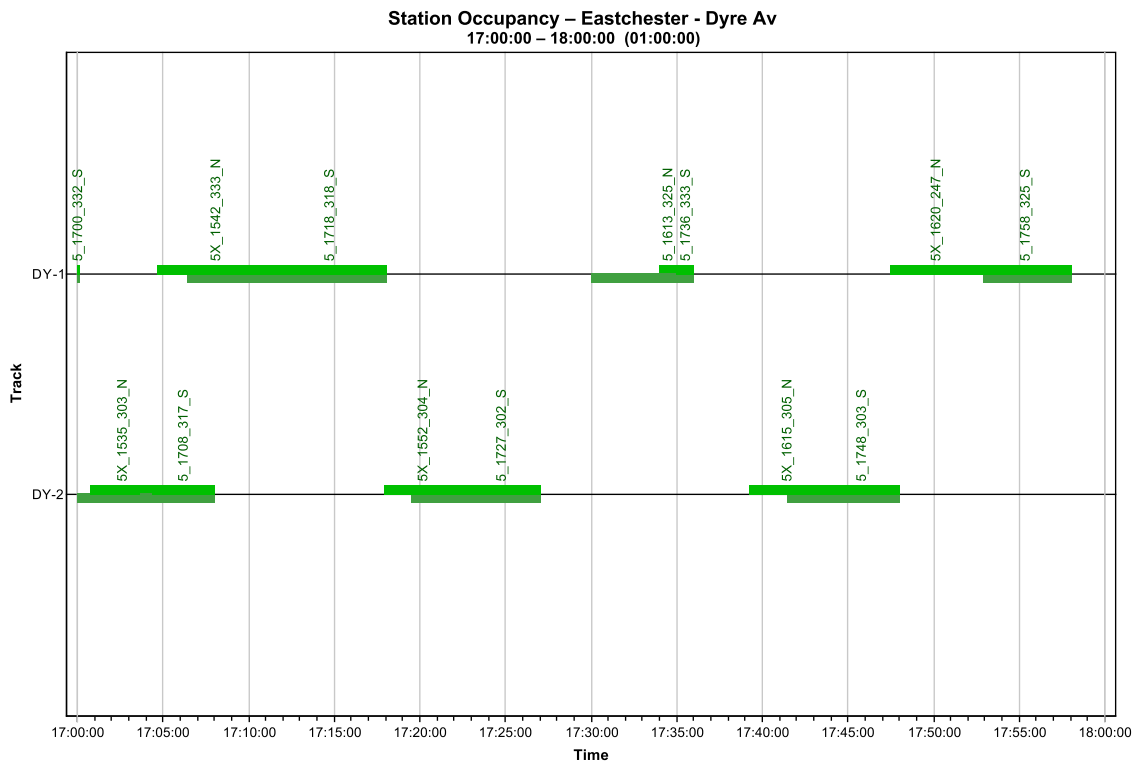
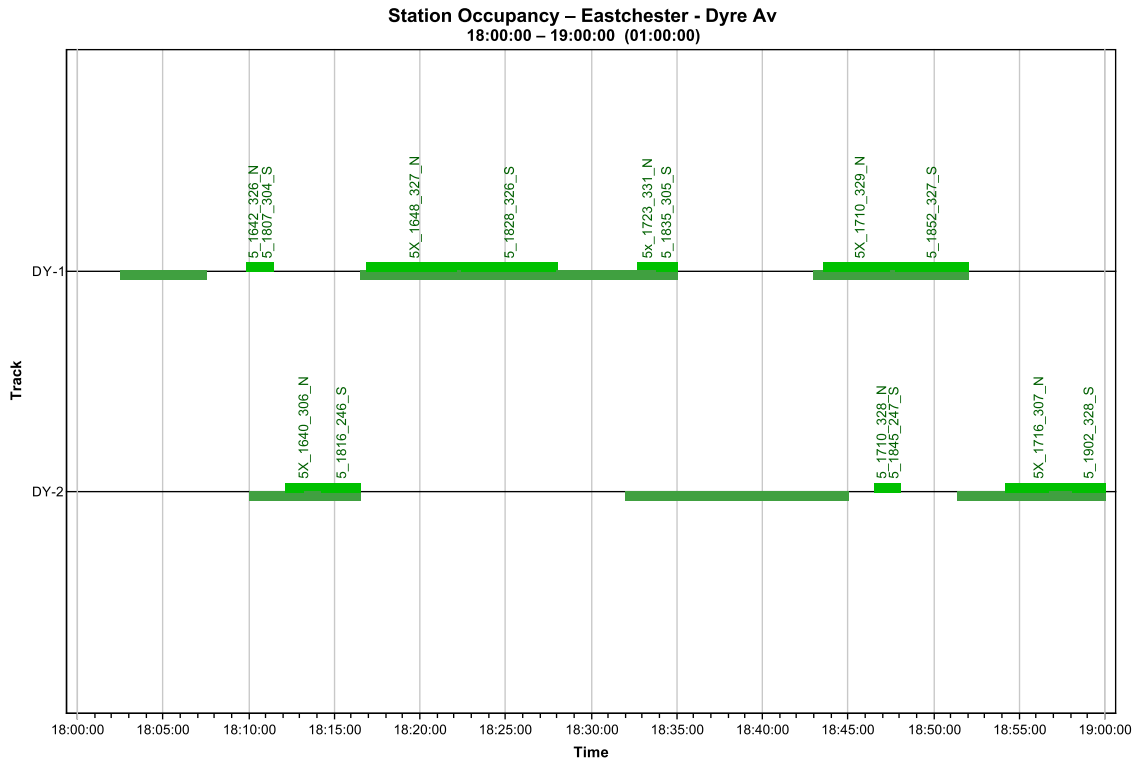


Figure F.4-47: Station Occupancy Chart – Eastchester-Dyre Avenue – 5:00 to 6:00 p.m.



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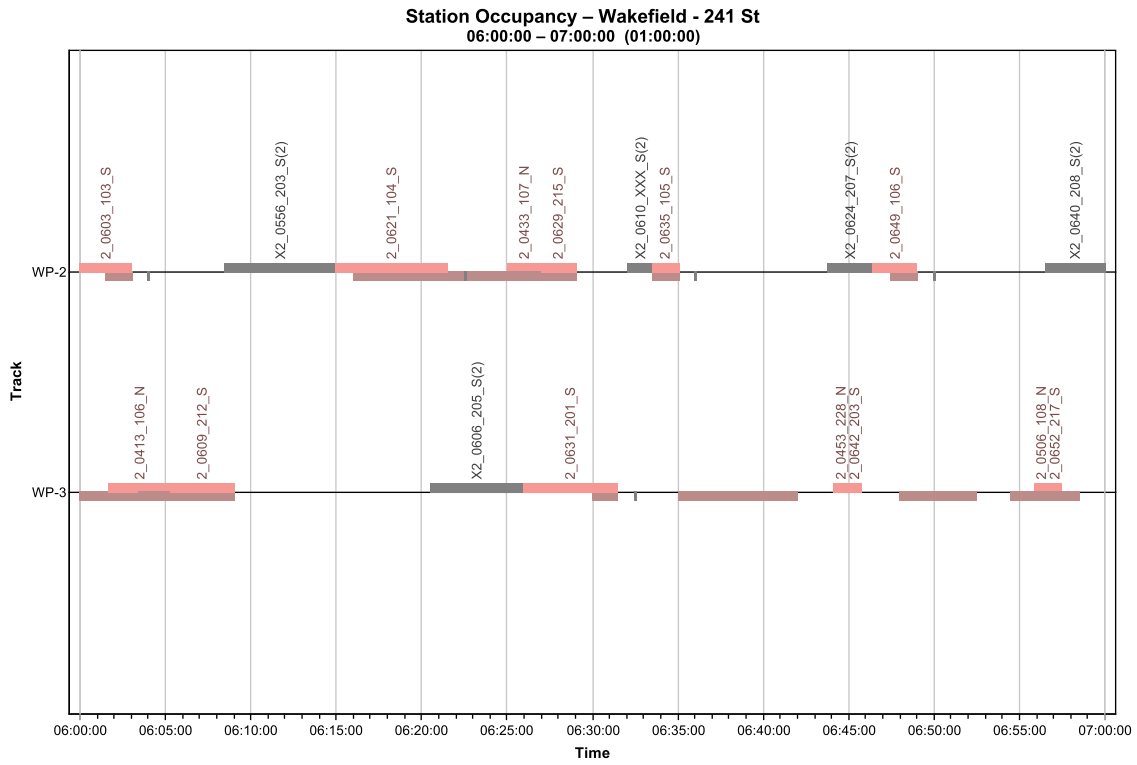
Figure F.4-48: Station Occupancy Chart – Eastchester-Dyre Avenue – 6:00 to 7:00 p.m.



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F.4.7 Wakefield-241 Street

Figure F.4-49: Station Occupancy Chart – Wakefield-241 Street – 6:00 to 7:00 a.m.



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Figure F.4-50: Station Occupancy Chart – Wakefield-241 Street – 7:00 to 8:00 a.m.

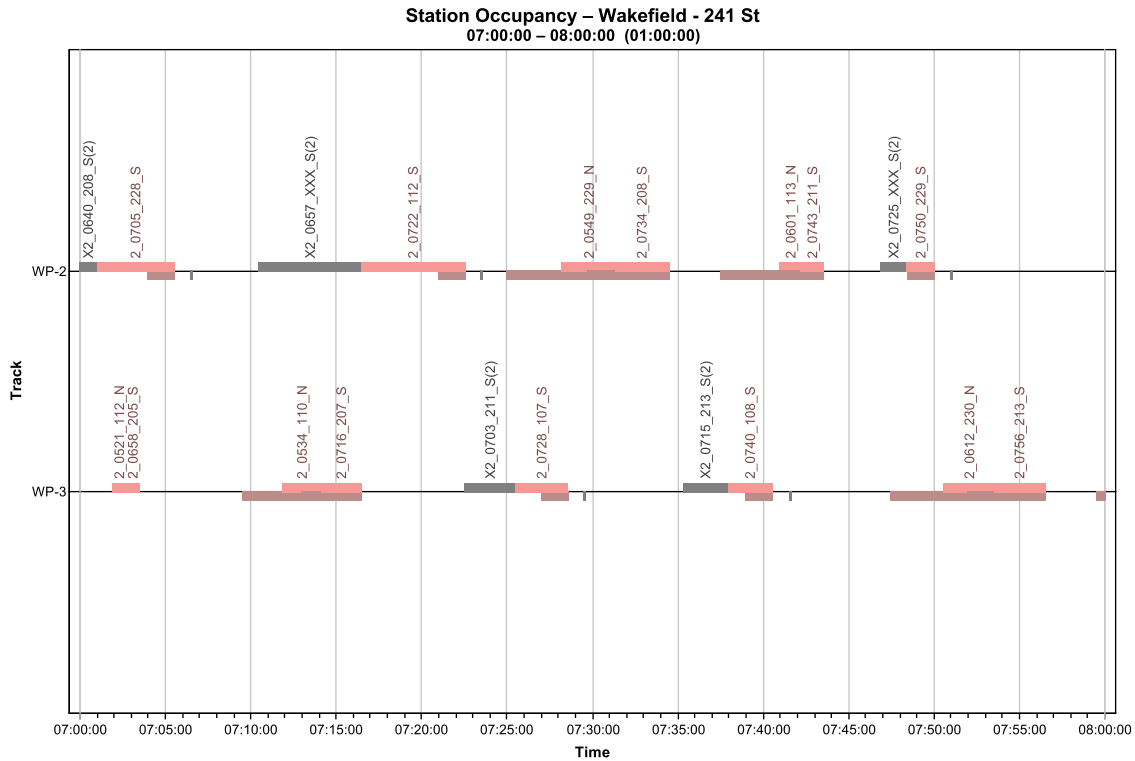
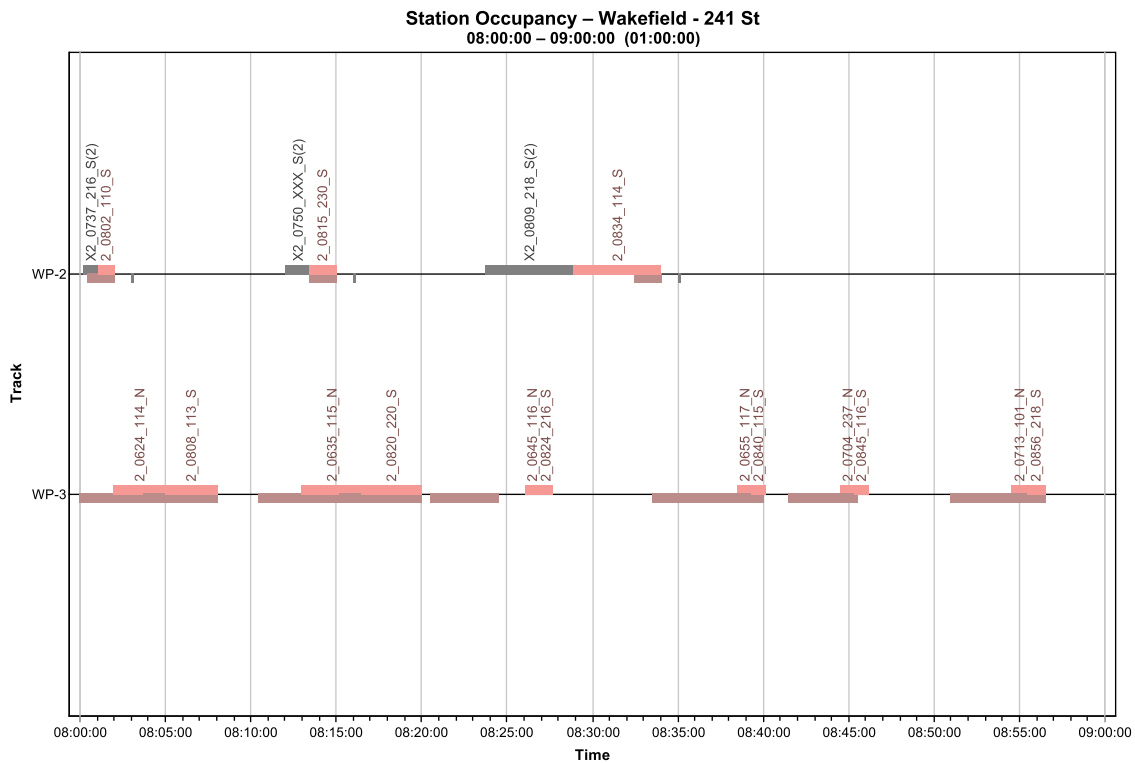


Figure F.4-51: Station Occupancy Chart – Wakefield-241 Street – 8:00 to 9:00 a.m.



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Figure F.4-52: Station Occupancy Chart – Wakefield-241 Street – 9:00 to 10:00 a.m.

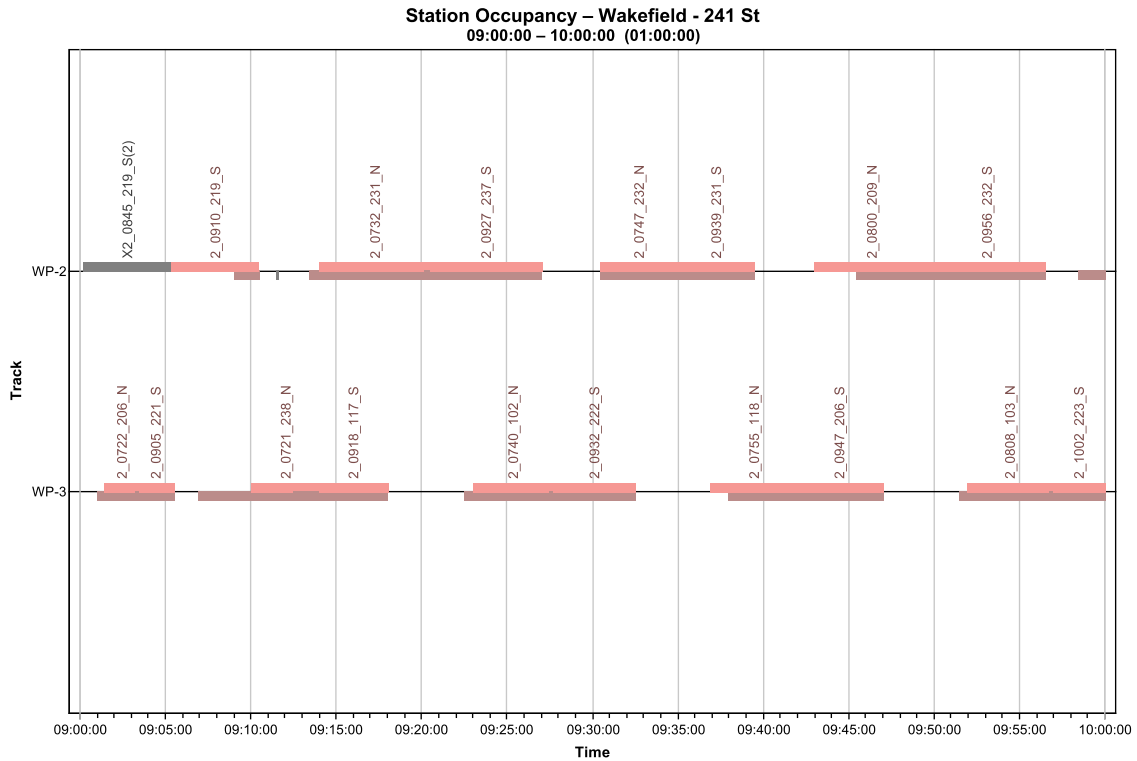
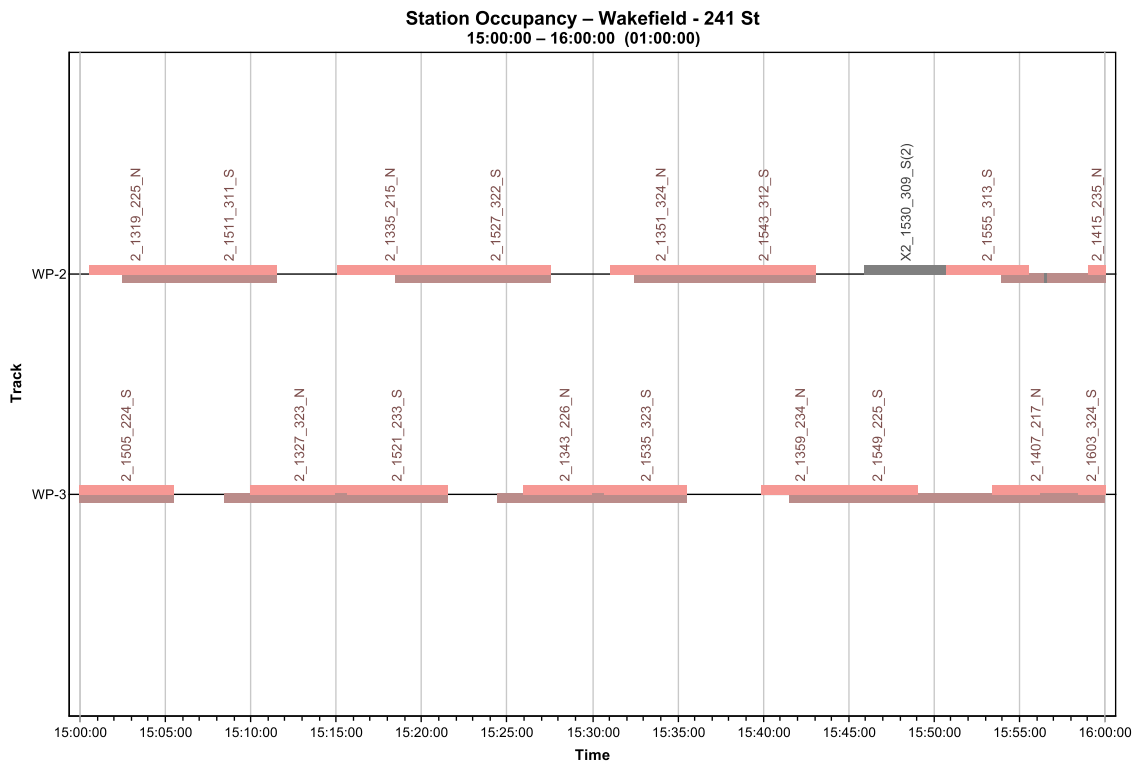


Figure F.4-53: Station Occupancy Chart – Wakefield-241 Street – 3:00 to 4:00 p.m.



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Figure F.4-54: Station Occupancy Chart – Wakefield-241 Street – 4:00 to 5:00 p.m.

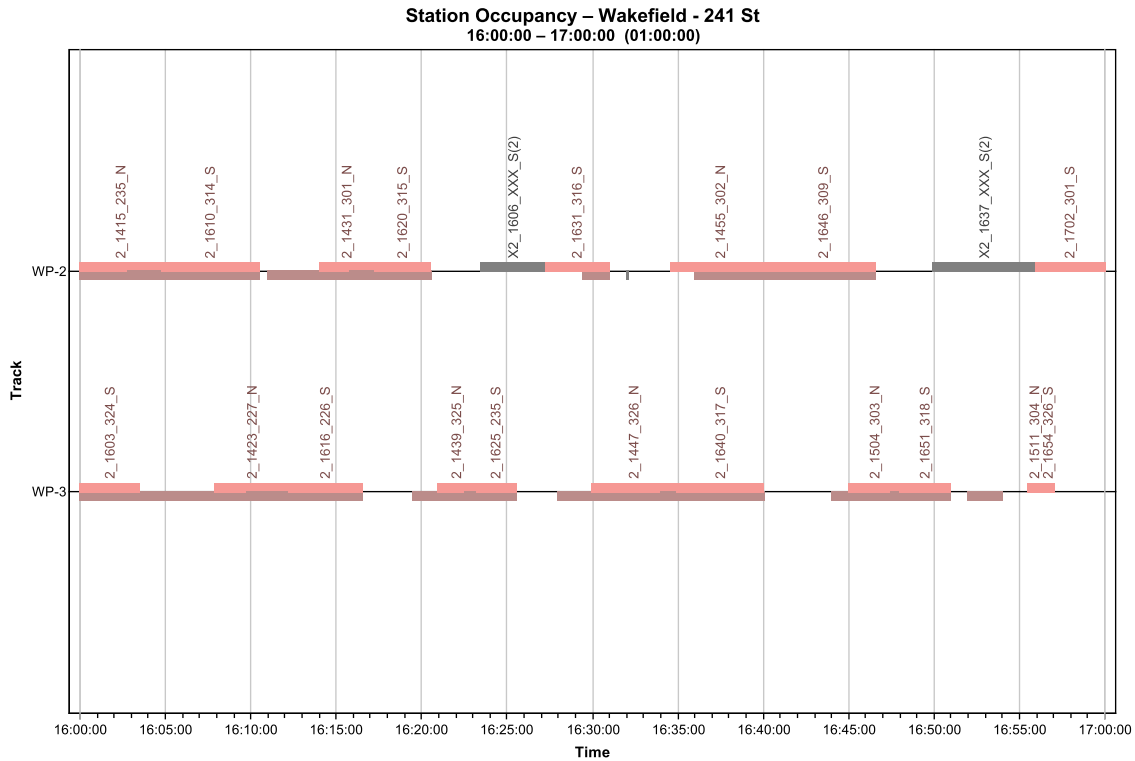
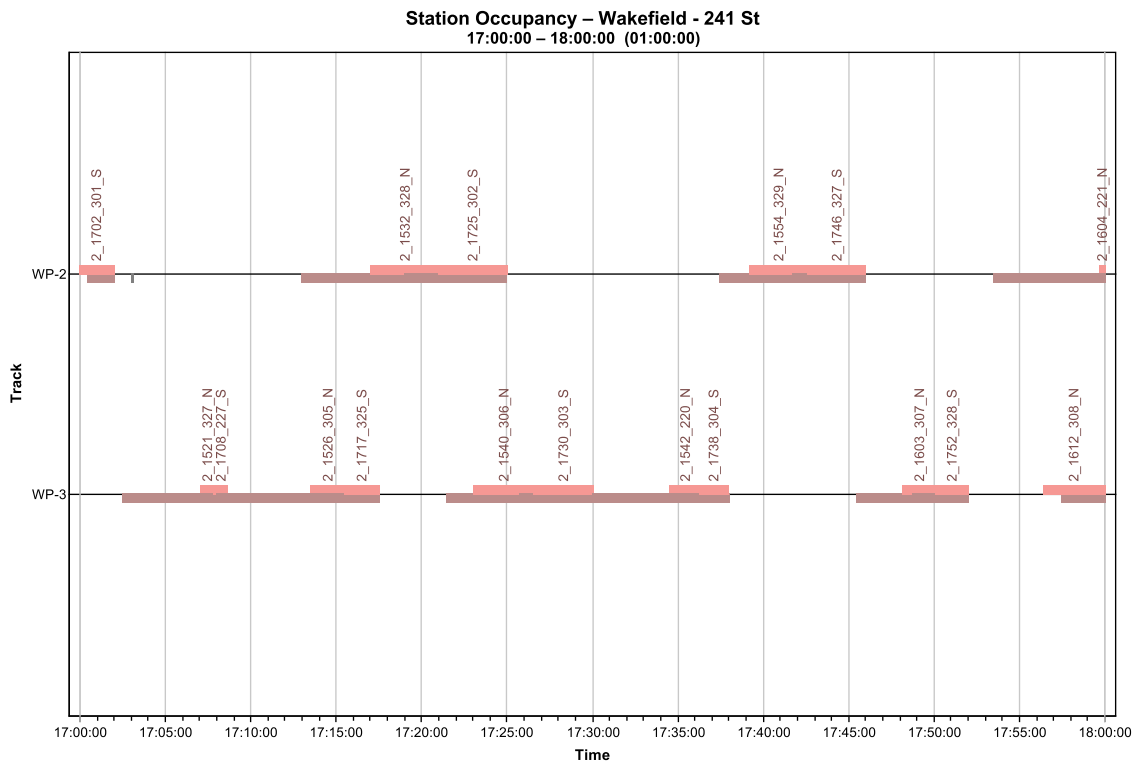
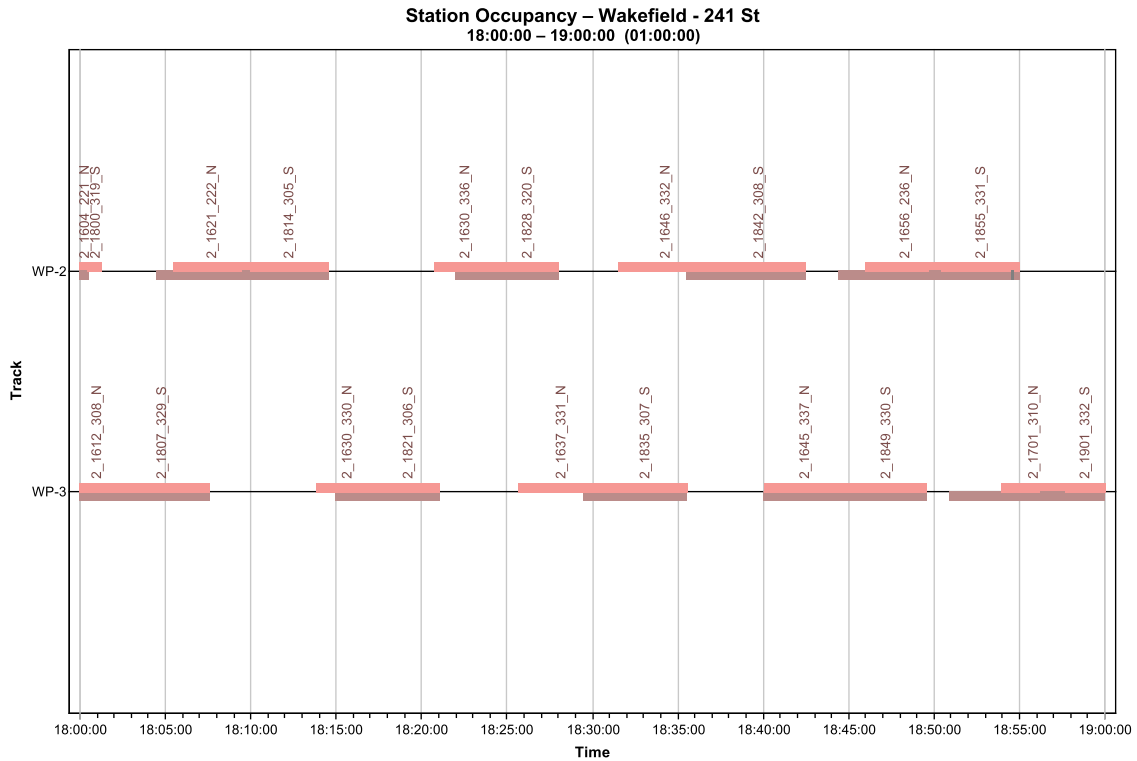


Figure F.4-55: Station Occupancy Chart – Wakefield-241 Street – 5:00 to 6:00 p.m.



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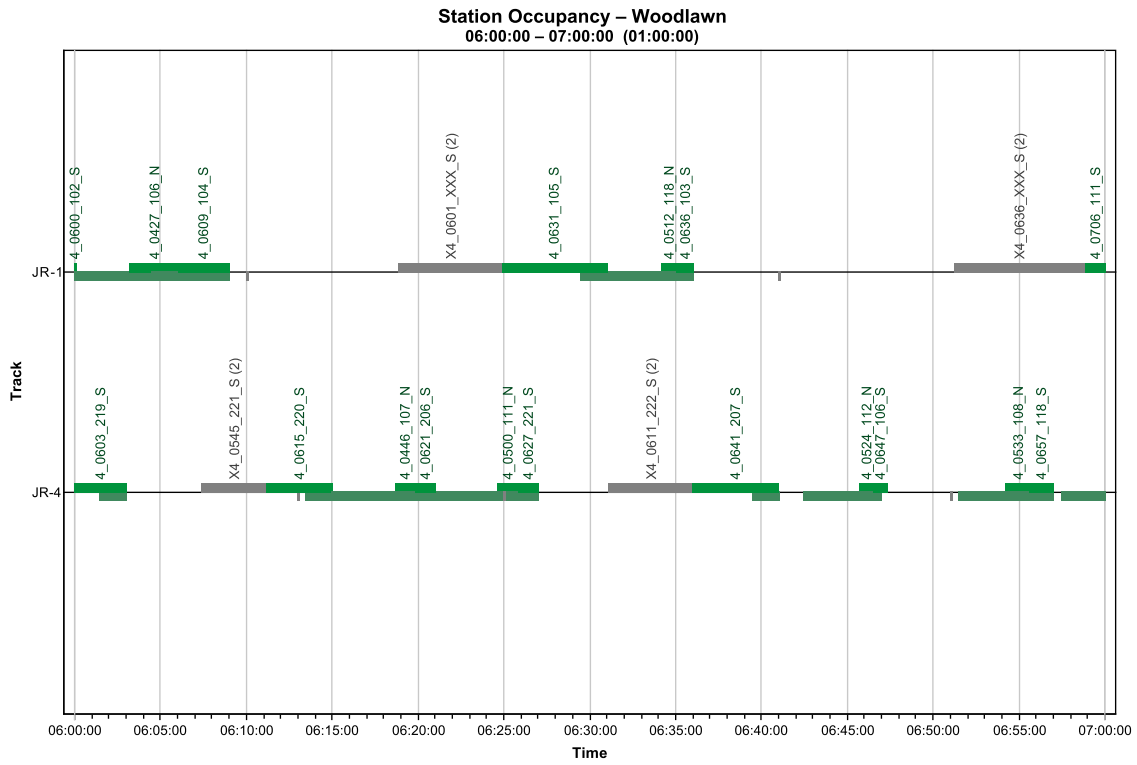
Figure F.4-56: Station Occupancy Chart – Wakefield-241 Street – 6:00 to 7:00 p.m.



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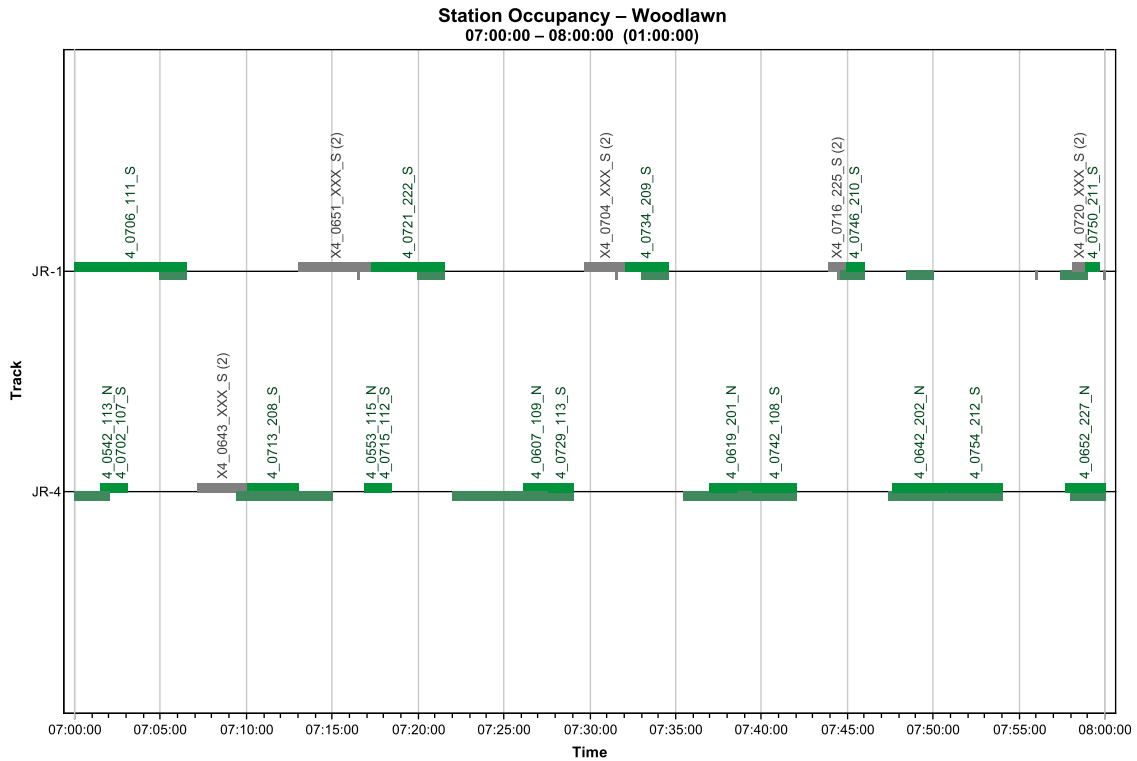
F.4.8 Woodlawn

Figure F.4-57: Station Occupancy Chart – Woodlawn – 6:00 to 7:00 a.m.



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Figure F.4-58: Station Occupancy Chart – Woodlawn – 7:00 to 8:00 a.m.



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Figure F.4-59: Station Occupancy Chart – Woodlawn – 8:00 to 9:00 a.m.

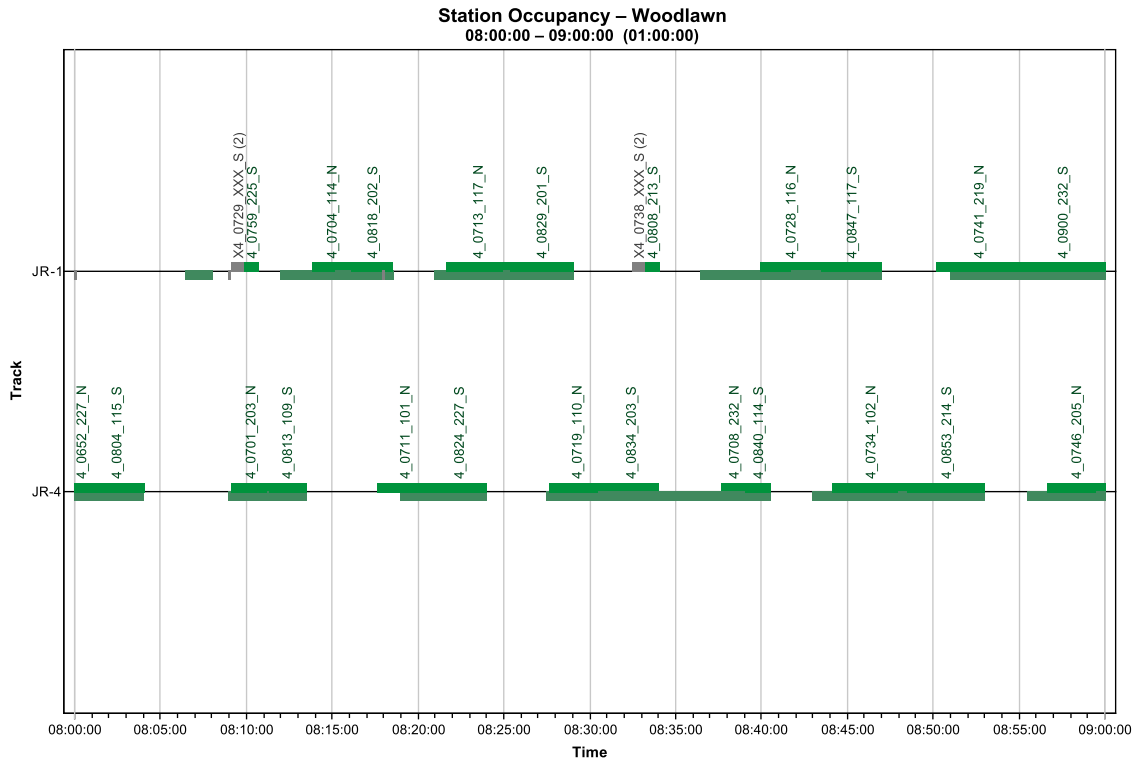
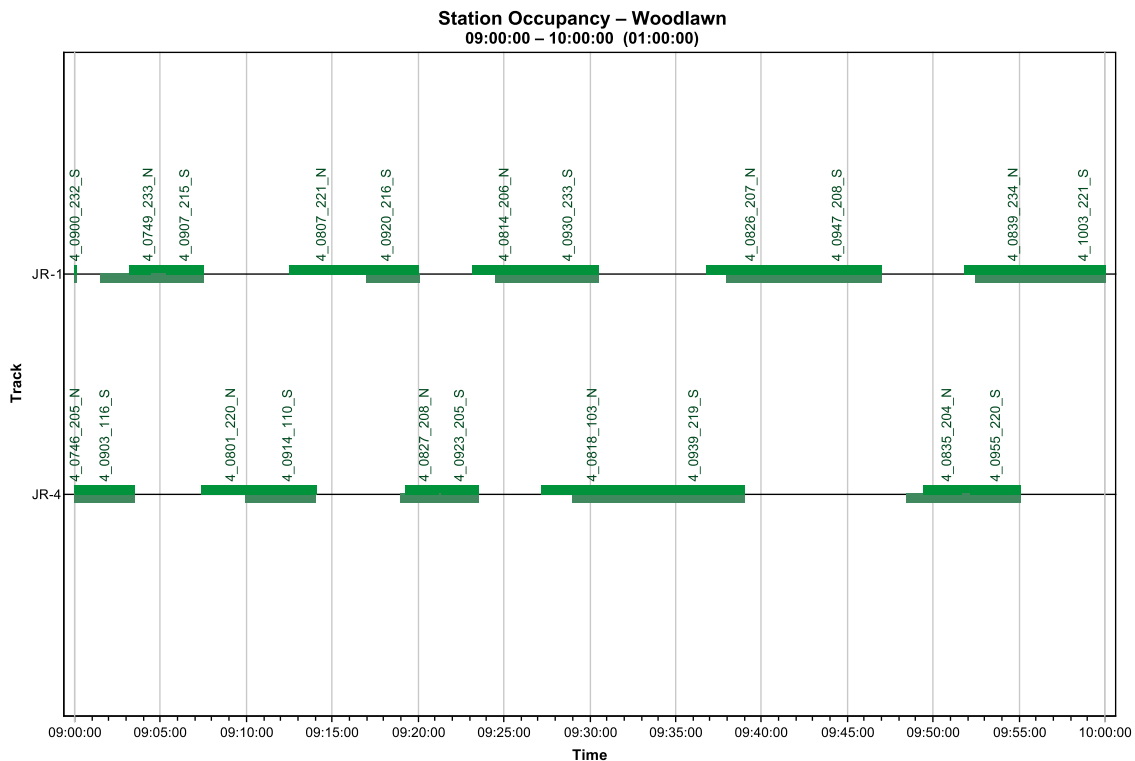


Figure F.4-60: Station Occupancy Chart – Woodlawn – 9:00 to 10:00 a.m.



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Figure F.4-61: Station Occupancy Chart – Woodlawn – 3:00 to 4:00 p.m.

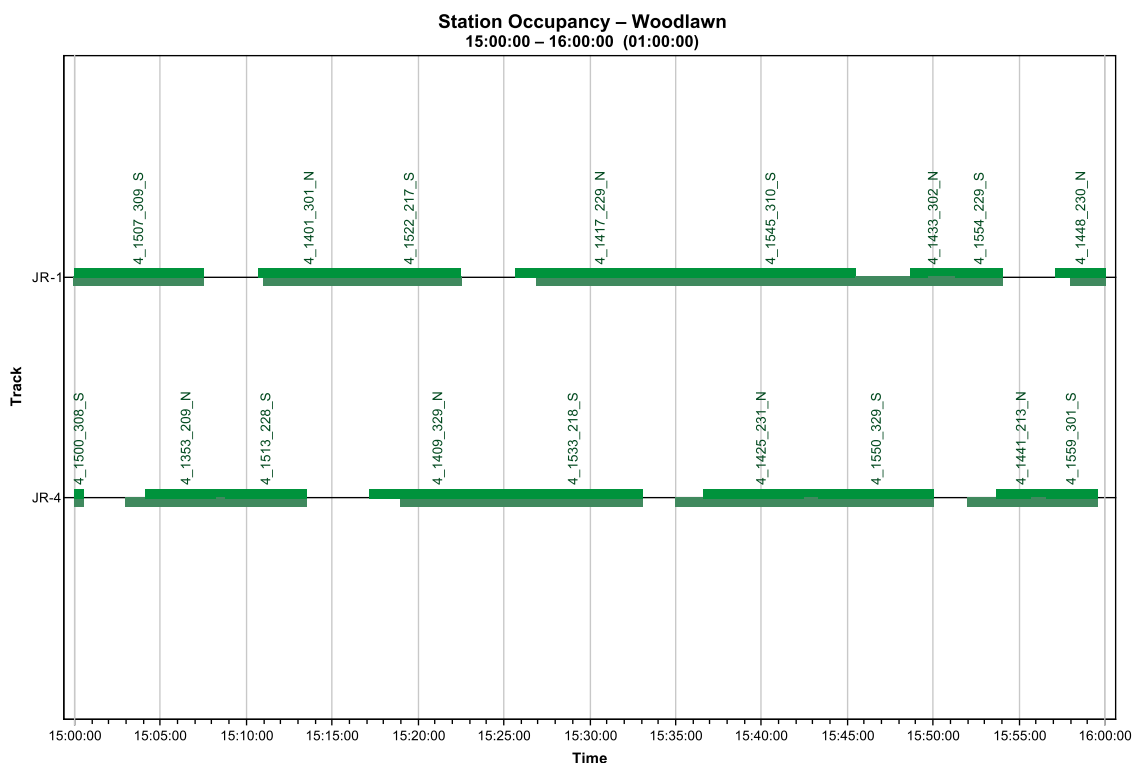
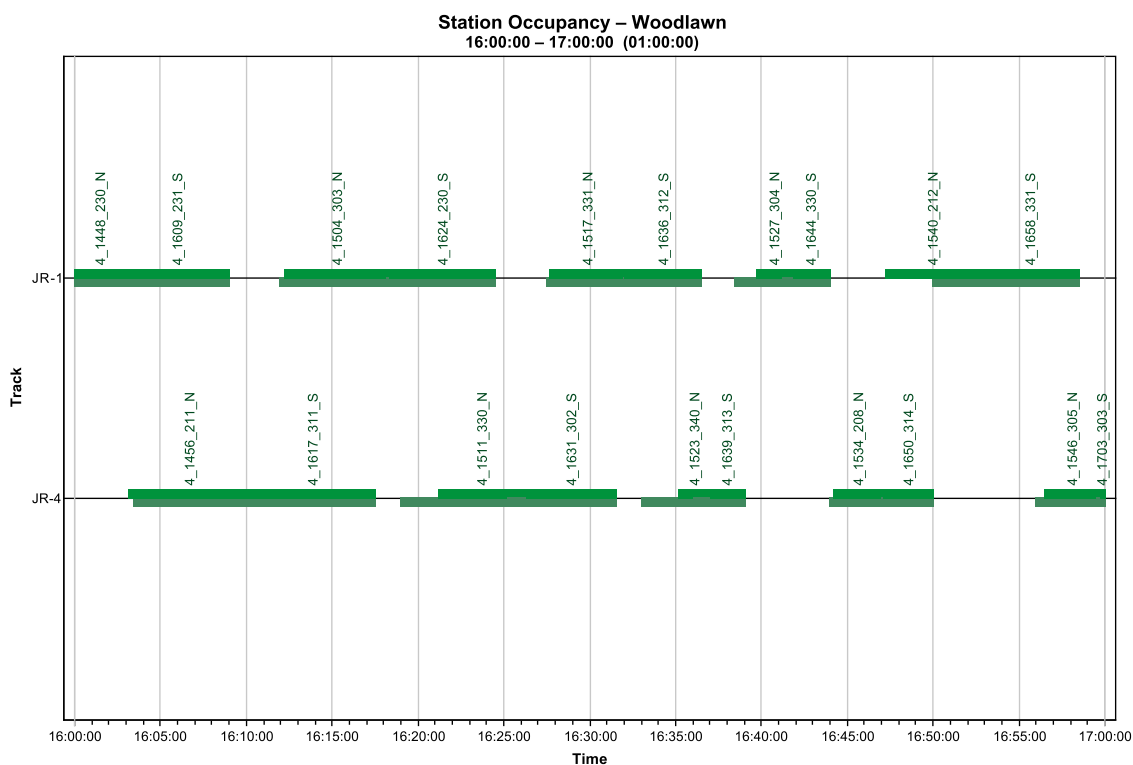


Figure F.4-62: Station Occupancy Chart – Woodlawn – 4:00 to 5:00 p.m.



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Figure F.4-63: Station Occupancy Chart – Woodlawn – 5:00 to 6:00 p.m.

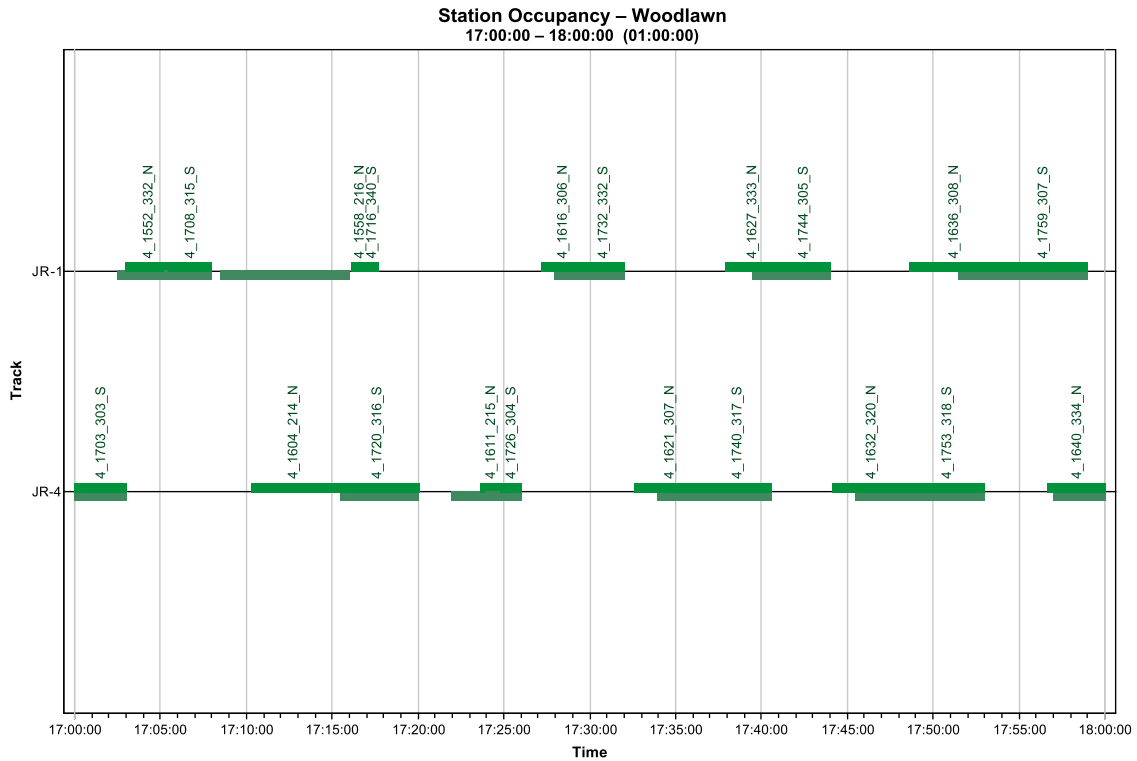
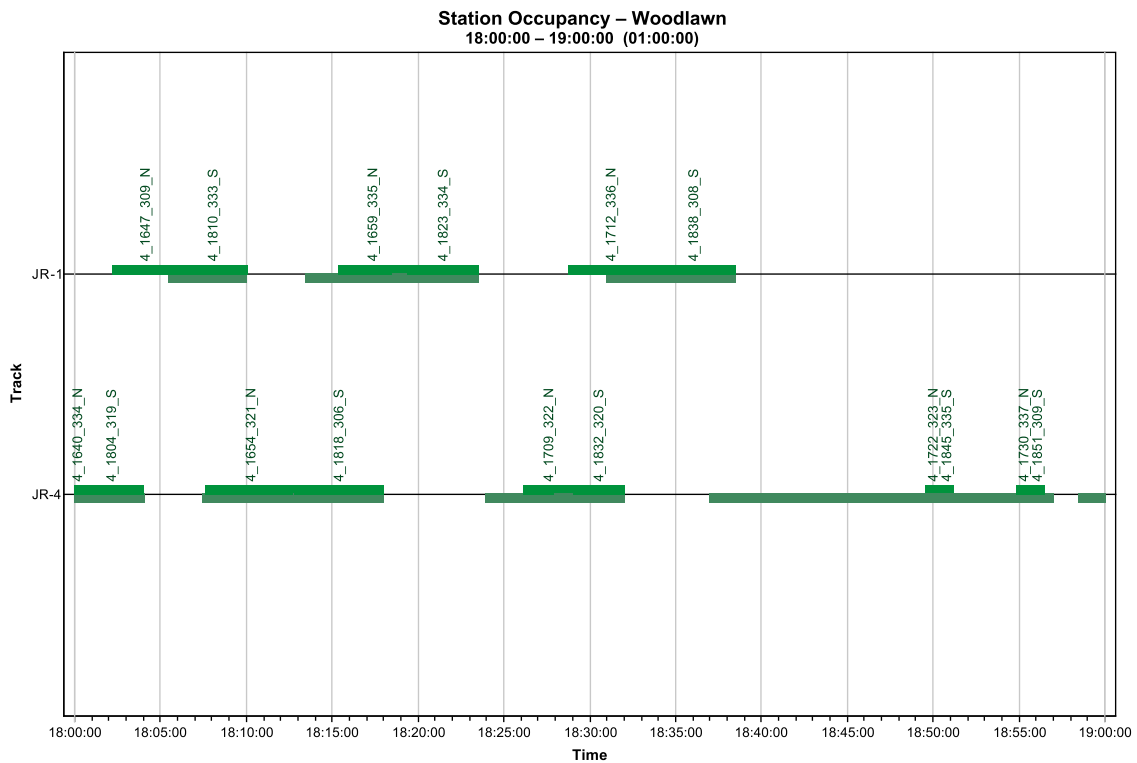


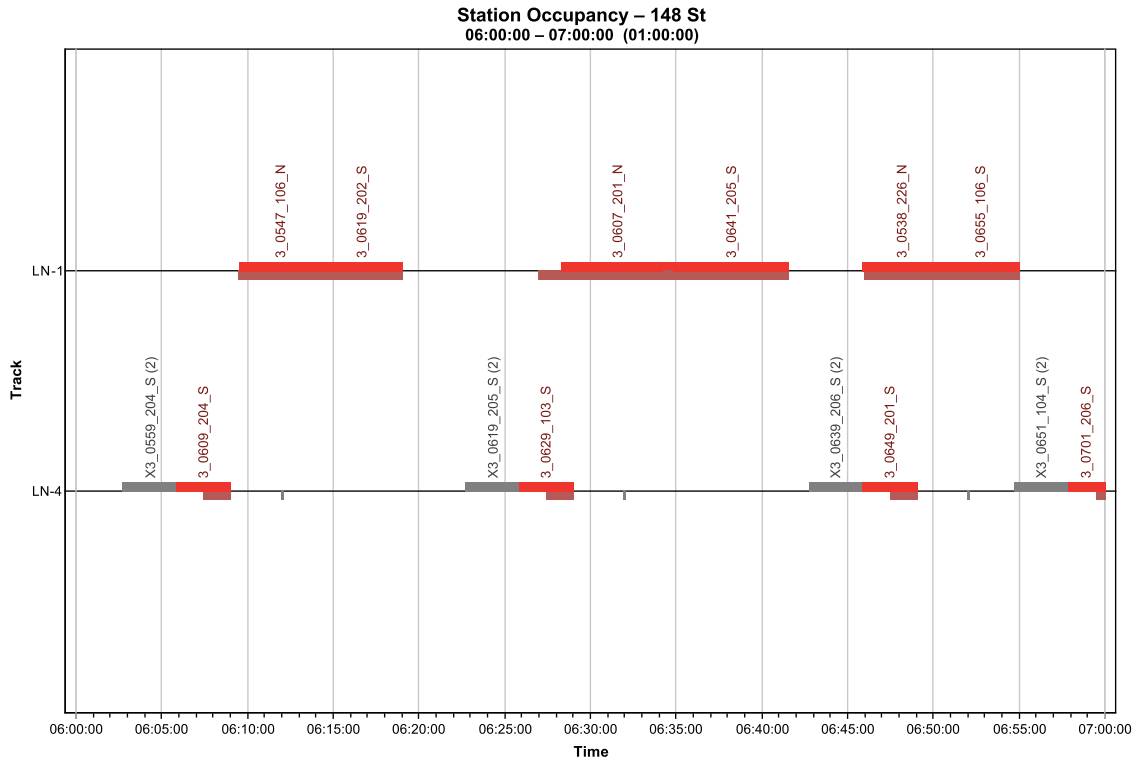
Figure F.4-64: Station Occupancy Chart – Woodlawn – 6:00 to 7:00 p.m.



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F.4.9 Harlem-148 Street

Figure F.4-65: Station Occupancy Chart – Harlem-148 Street – 6:00 to 7:00 a.m.



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Figure F.4-66: Station Occupancy Chart – Harlem-148 Street – 7:00 to 8:00 a.m.

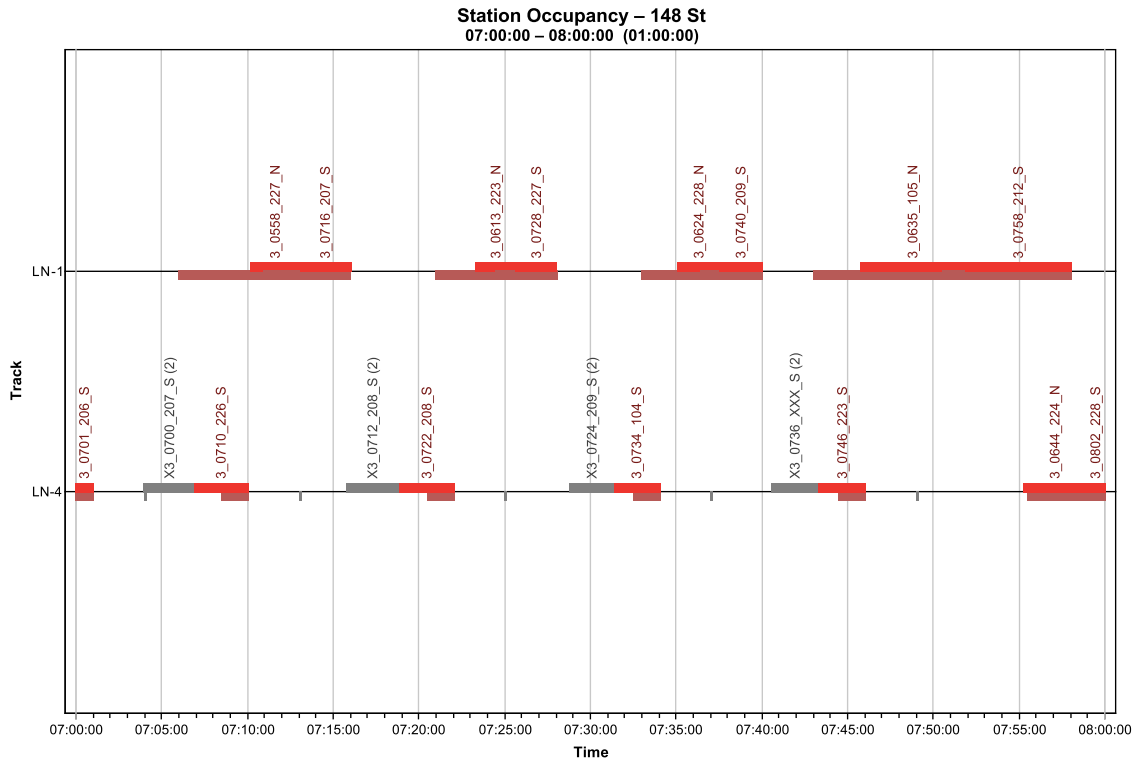
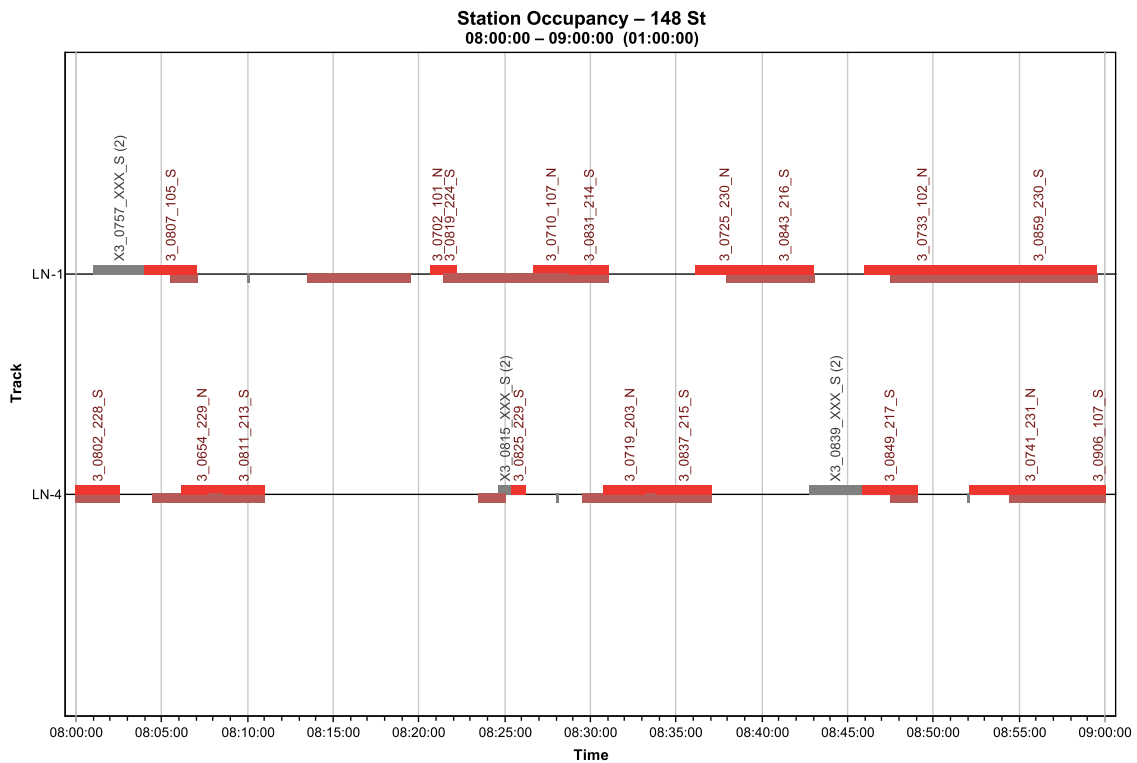


Figure F.4-67: Station Occupancy Chart – Harlem-148 Street – 8:00 to 9:00 a.m.



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Figure F.4-68: Station Occupancy Chart – Harlem-148 Street – 9:00 to 10:00 a.m.

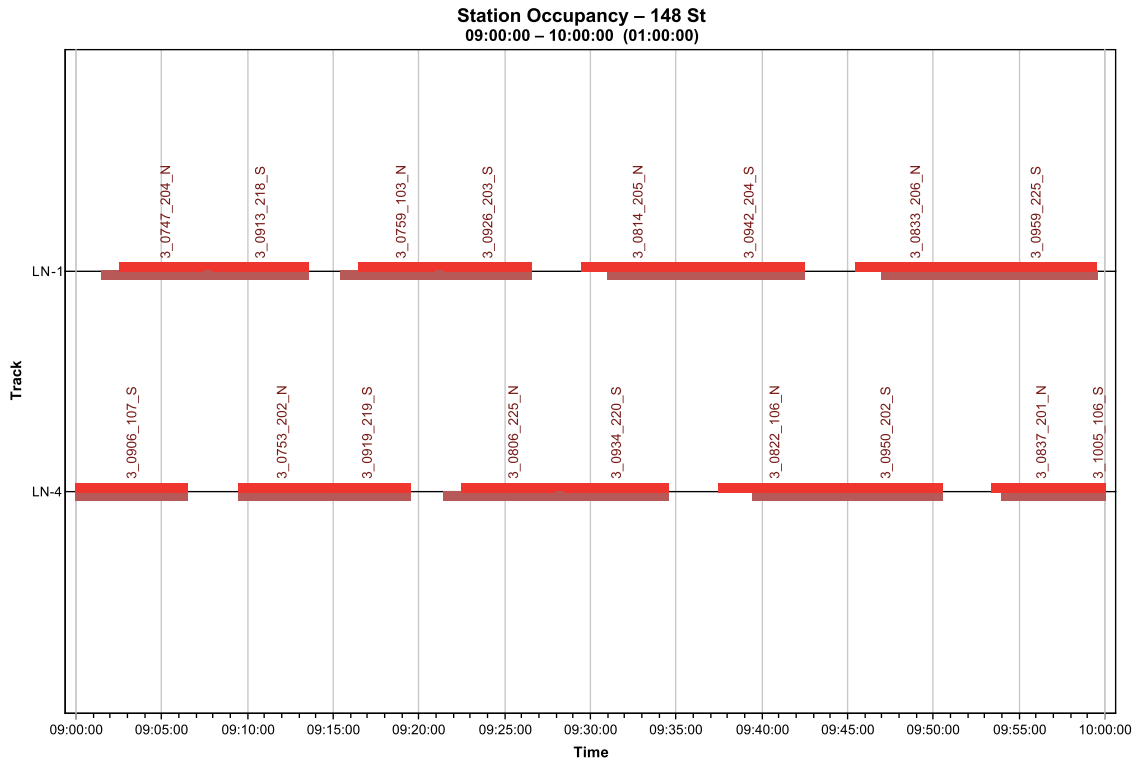
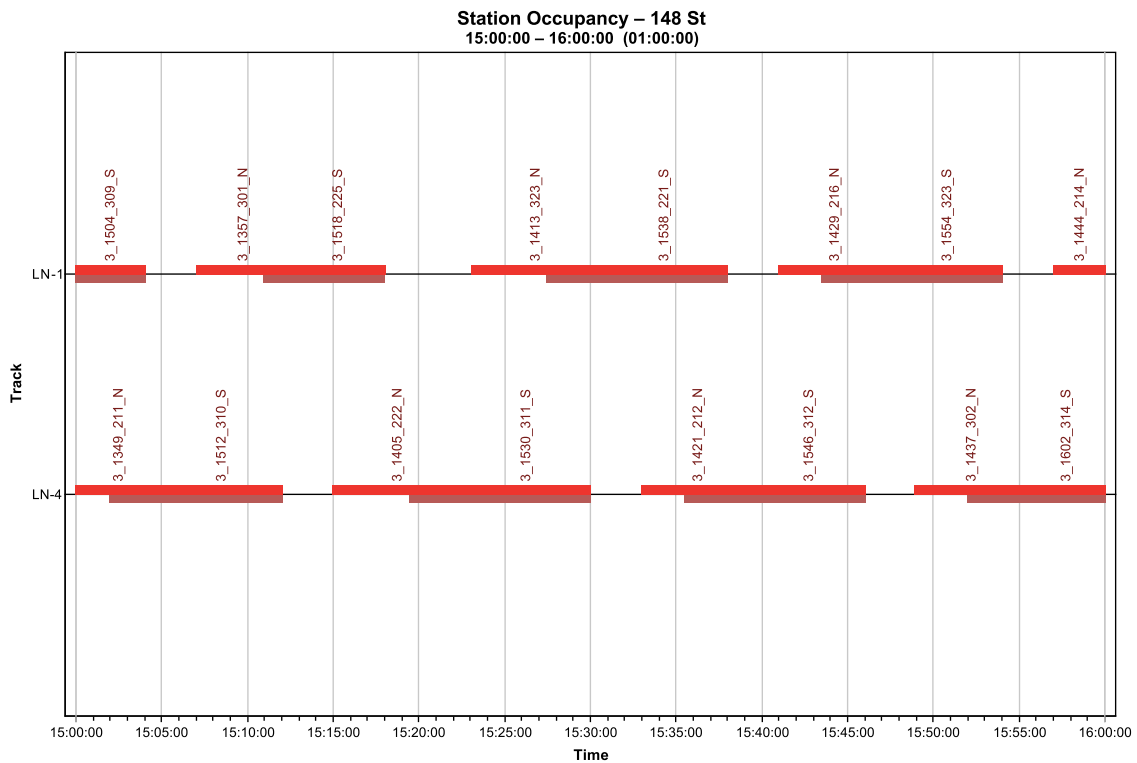


Figure F.4-69: Station Occupancy Chart – Harlem-148 Street – 3:00 to 4:00 p.m.



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Figure F.4-70: Station Occupancy Chart – Harlem-148 Street – 4:00 to 5:00 p.m.

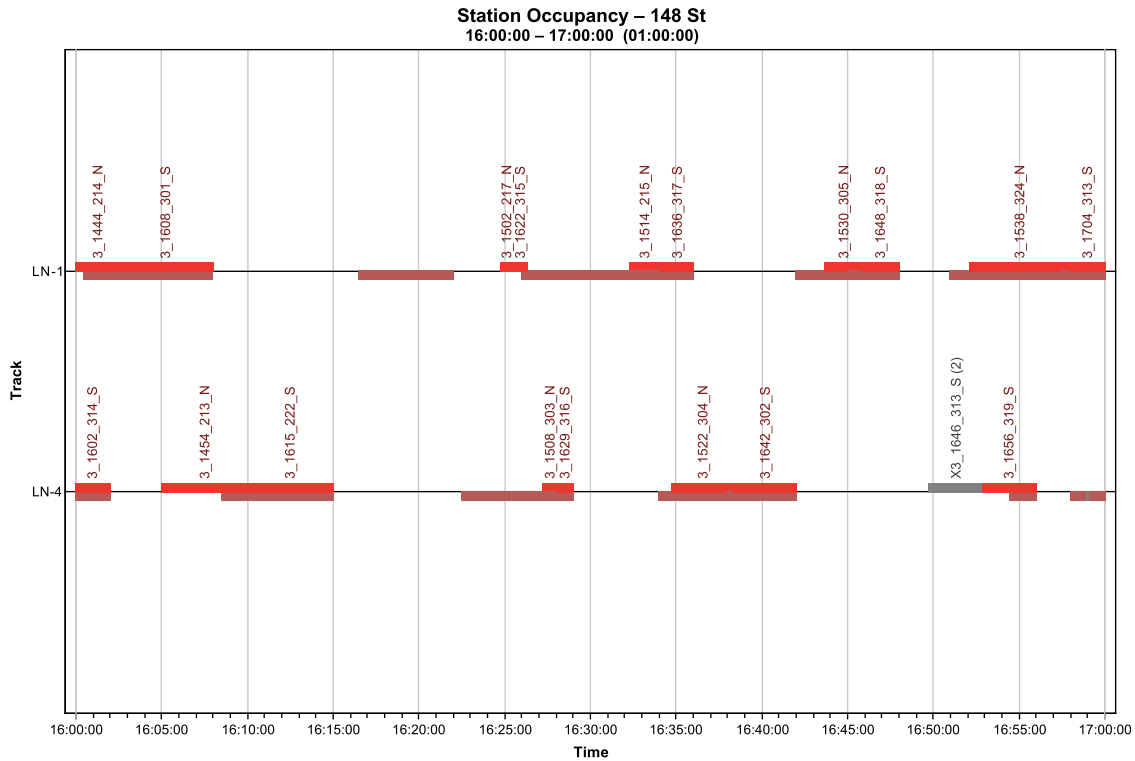
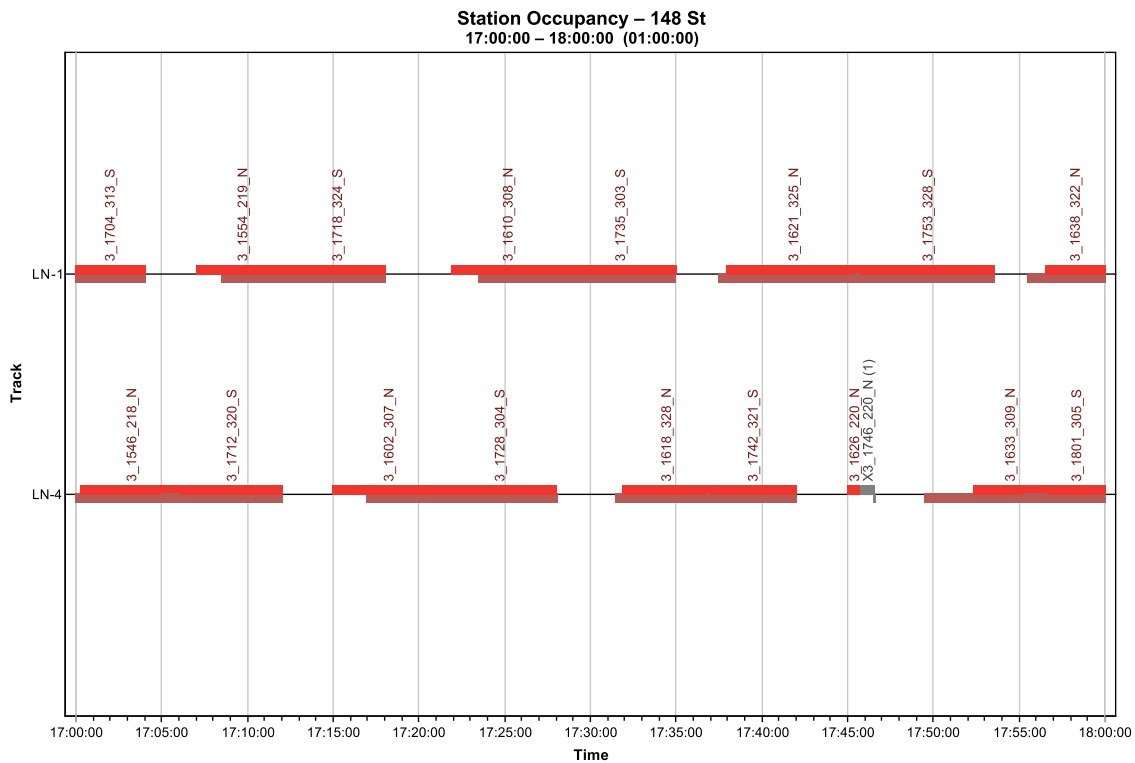
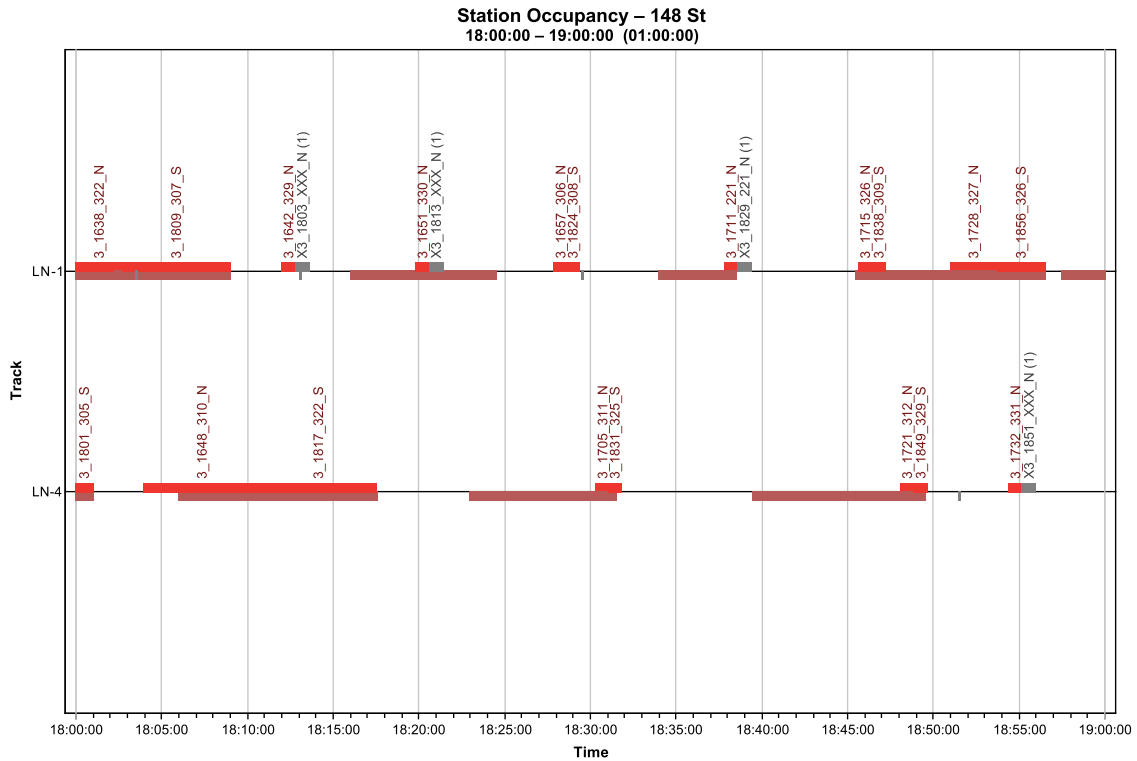


Figure F.4-71: Station Occupancy Chart – Harlem-148 Street – 5:00 to 6:00 p.m.



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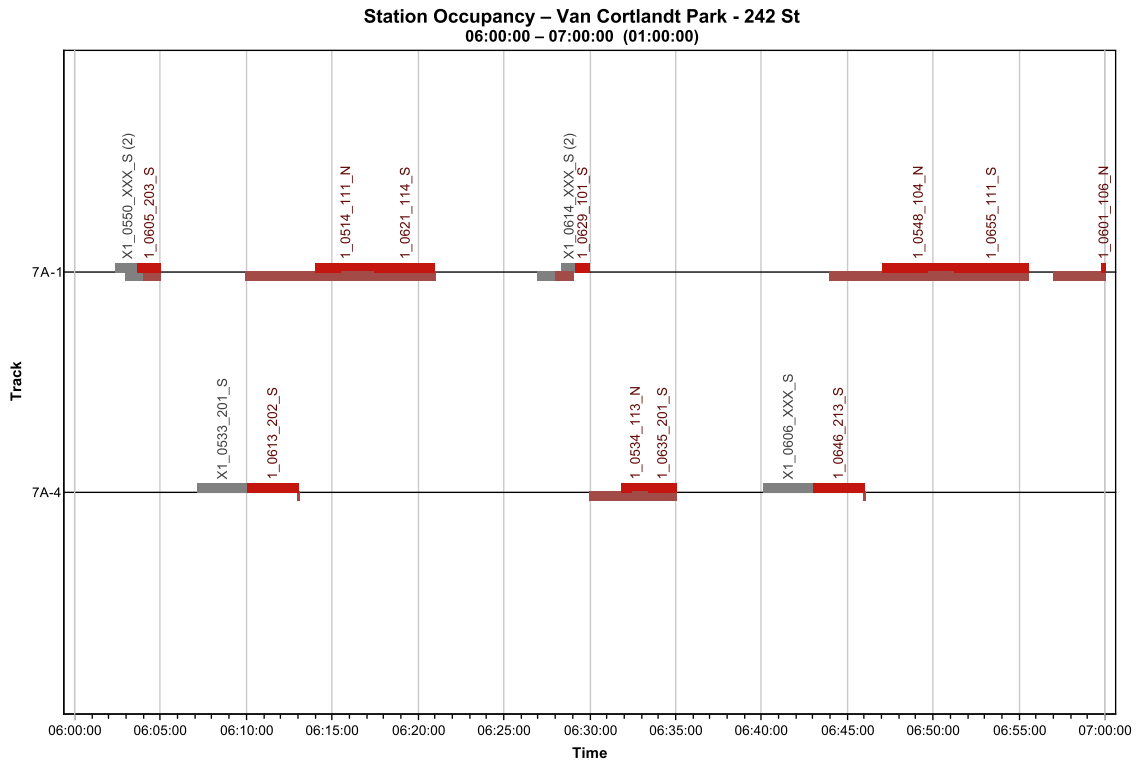
Figure F.4-72: Station Occupancy Chart – Harlem-148 Street – 6:00 to 7:00 p.m.



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F.4.10 Van Cortlandt Park-242 Street

Figure F.4-73: Station Occupancy Chart – Van Cortlandt Park-242 Street – 6:00 to 7:00 a.m.



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Figure F.4-74: Station Occupancy Chart – Van Cortlandt Park-242 Street – 7:00 to 8:00 a.m.

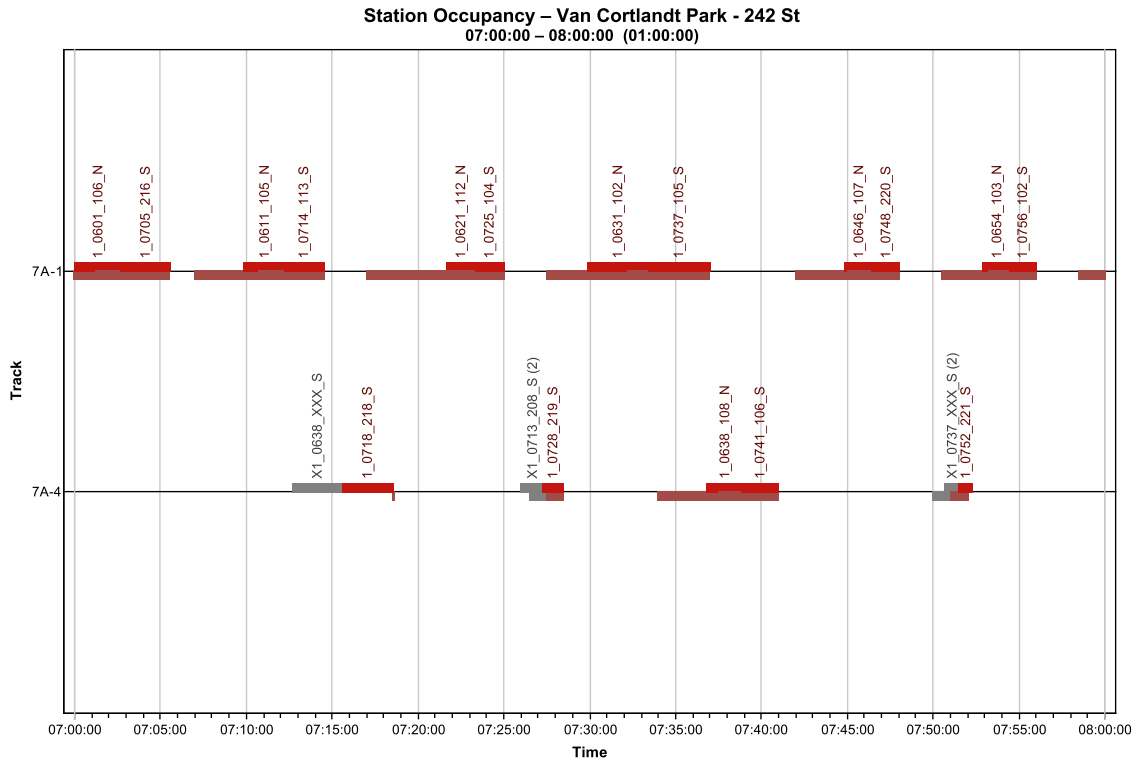
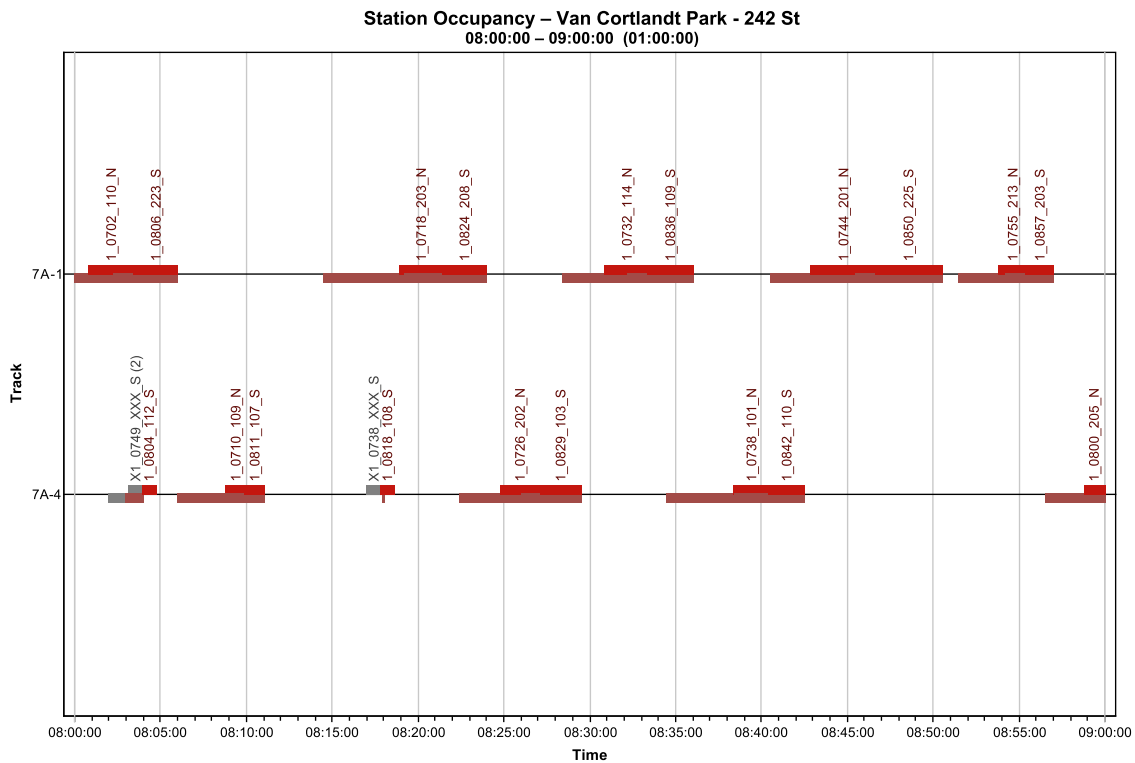


Figure F.4-75: Station Occupancy Chart – Van Cortlandt Park-242 Street – 8:00 to 9:00 a.m.



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Figure F.4-76: Station Occupancy Chart – Van Cortlandt Park-242 Street – 9:00 to 10:00 a.m.

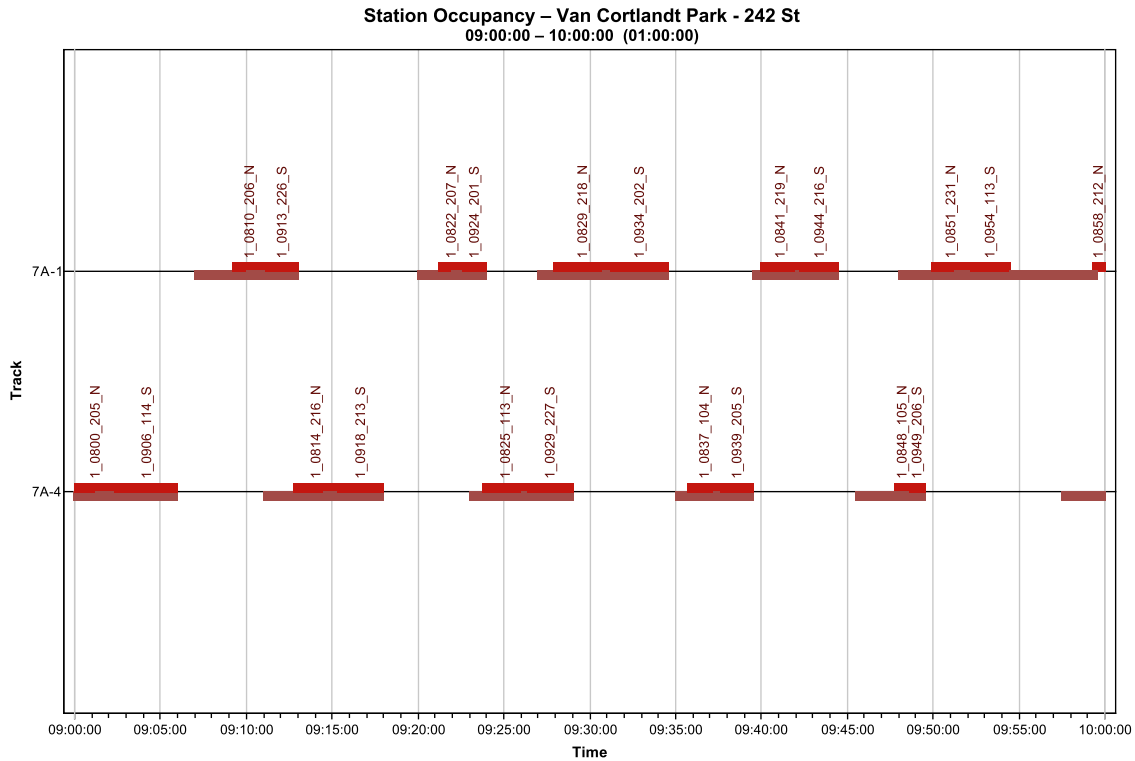
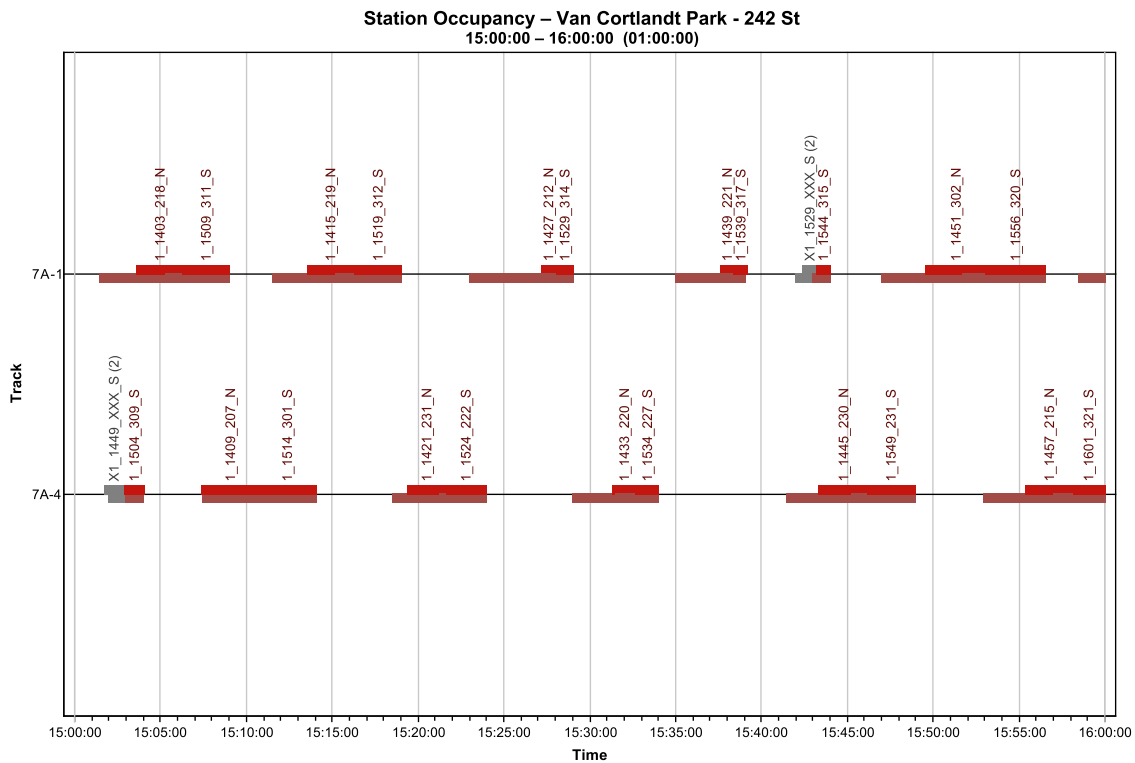


Figure F.4-77: Station Occupancy Chart – Van Cortlandt Park-242 Street – 3:00 to 4:00 p.m.



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Figure F.4-78: Station Occupancy Chart – Van Cortlandt Park-242 Street – 4:00 to 5:00 p.m.

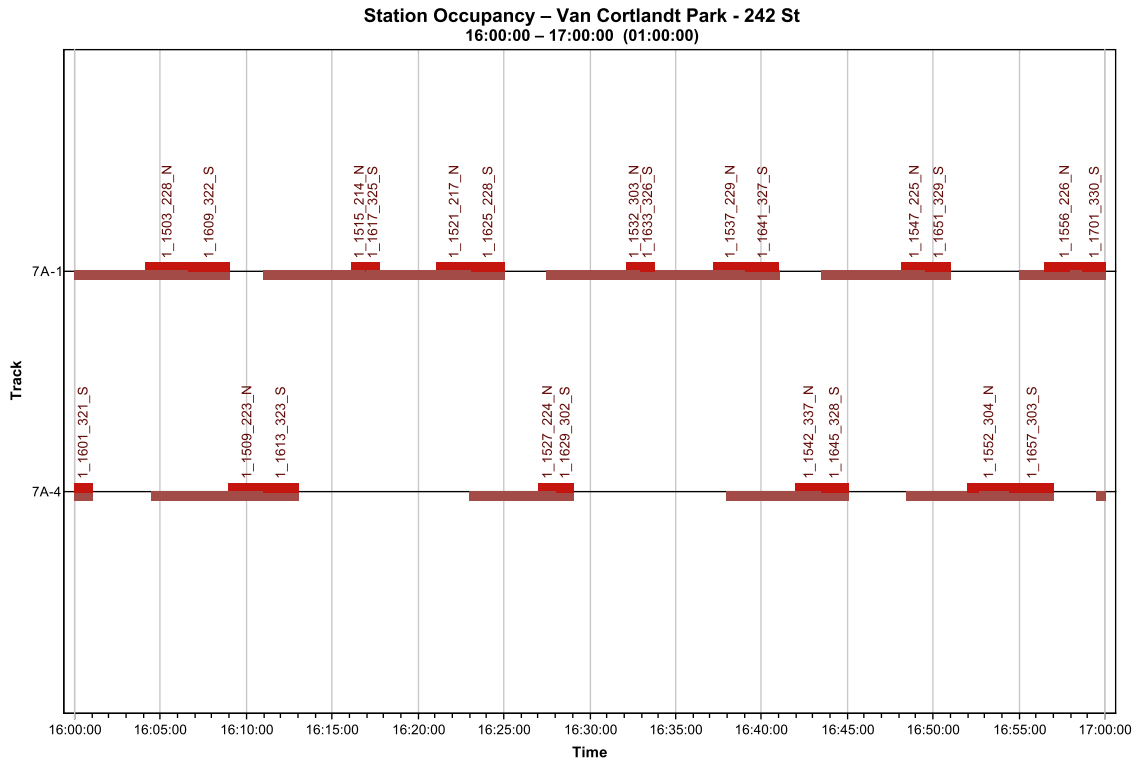
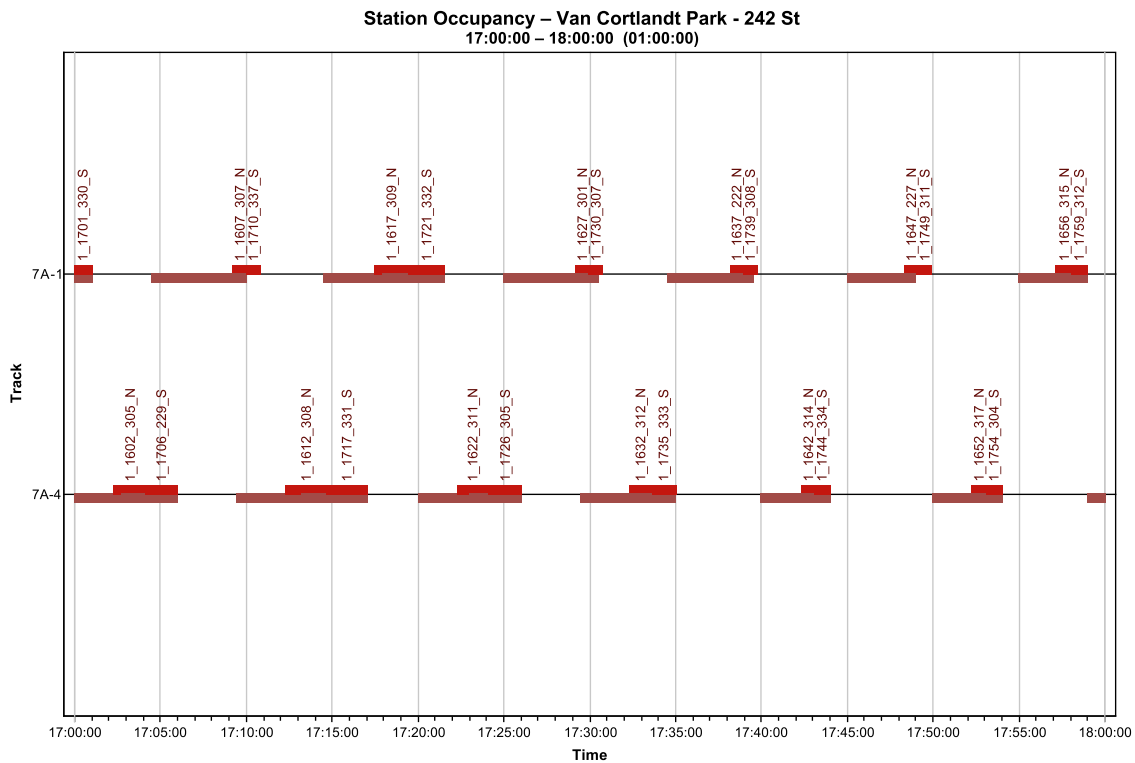
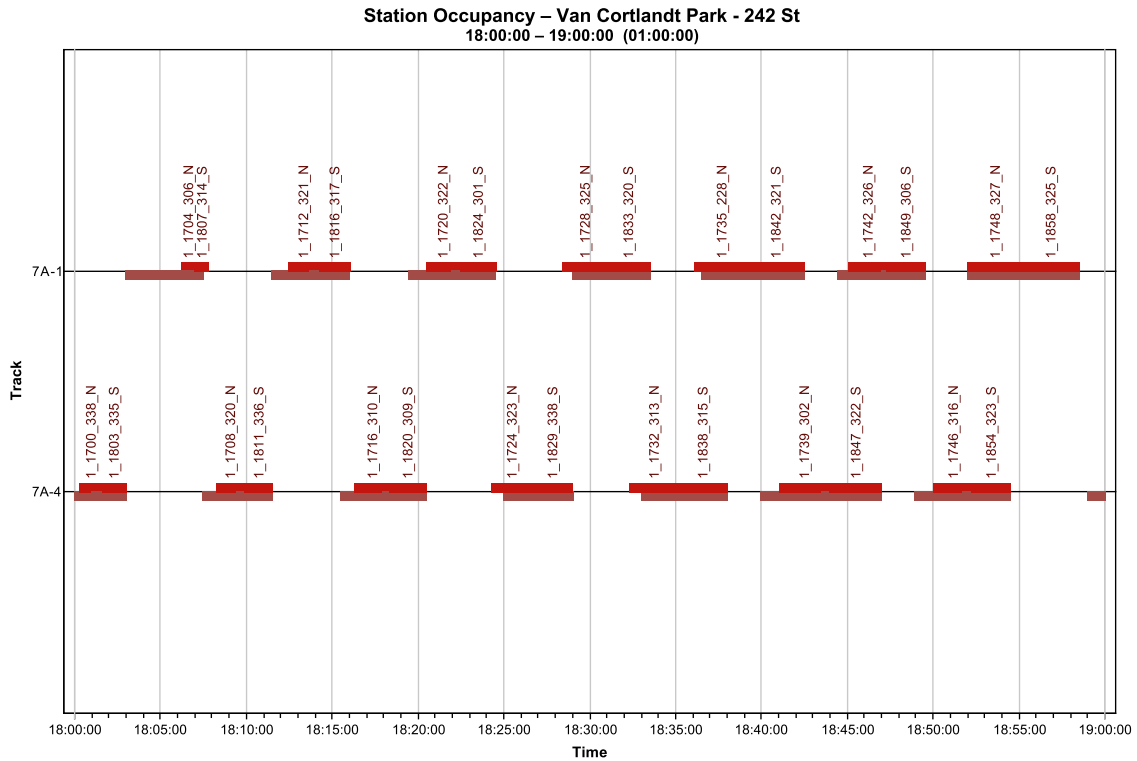


Figure F.4-79: Station Occupancy Chart – Van Cortlandt Park-242 Street – 5:00 to 6:00 p.m.



APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

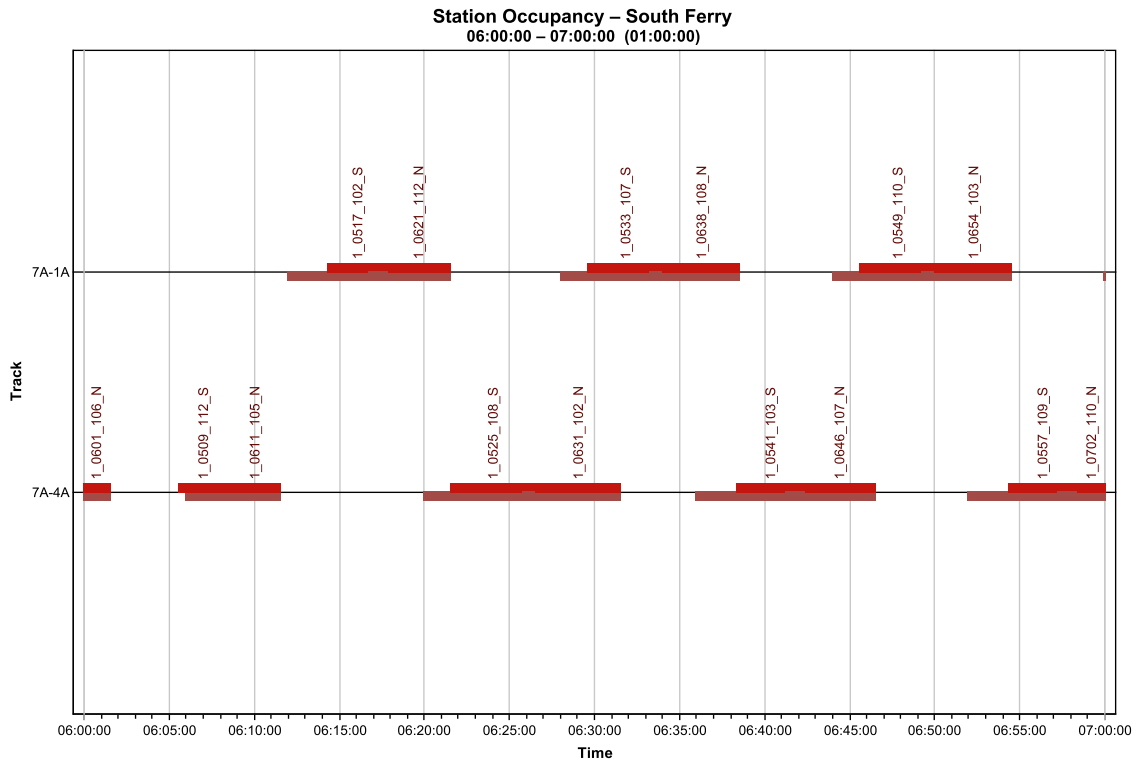
Figure F.4-80: Station Occupancy Chart – Van Cortlandt Park-242 Street – 6:00 to 7:00 p.m.



APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

F.4.11 South Ferry

Figure F.4-81: Station Occupancy Chart – South Ferry – 6:00 to 7:00 a.m.



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Figure F.4-82: Station Occupancy Chart – South Ferry – 7:00 to 8:00 a.m.

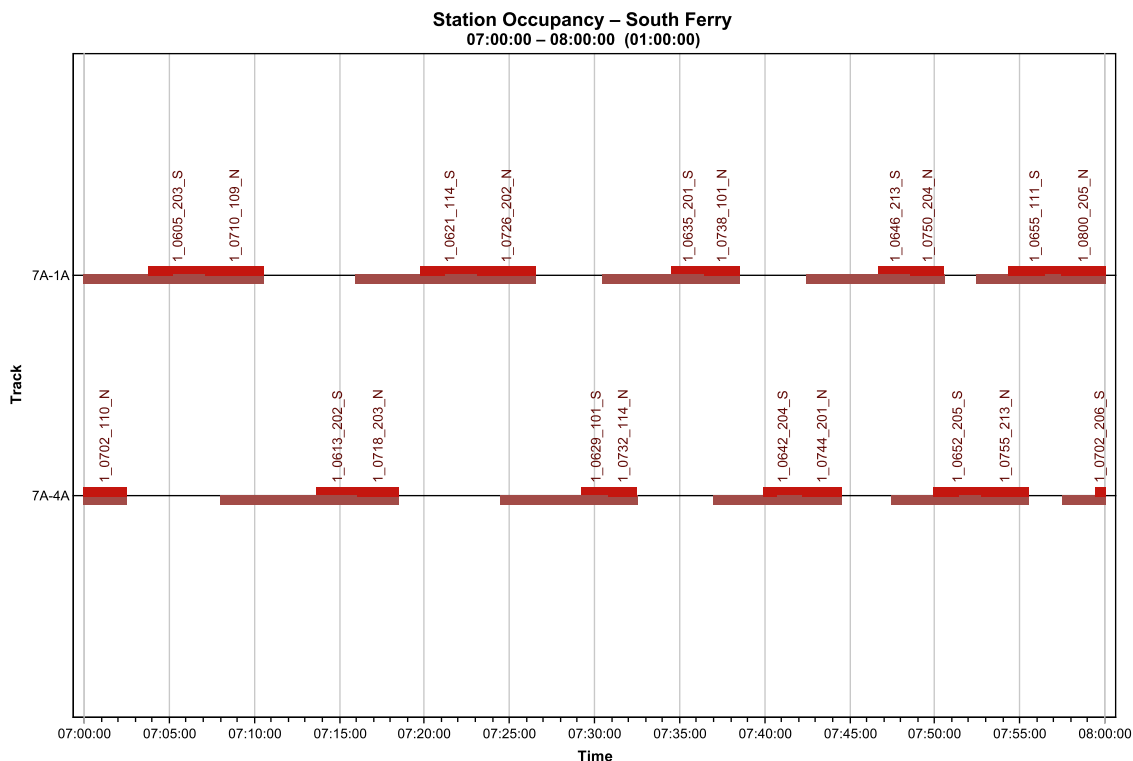
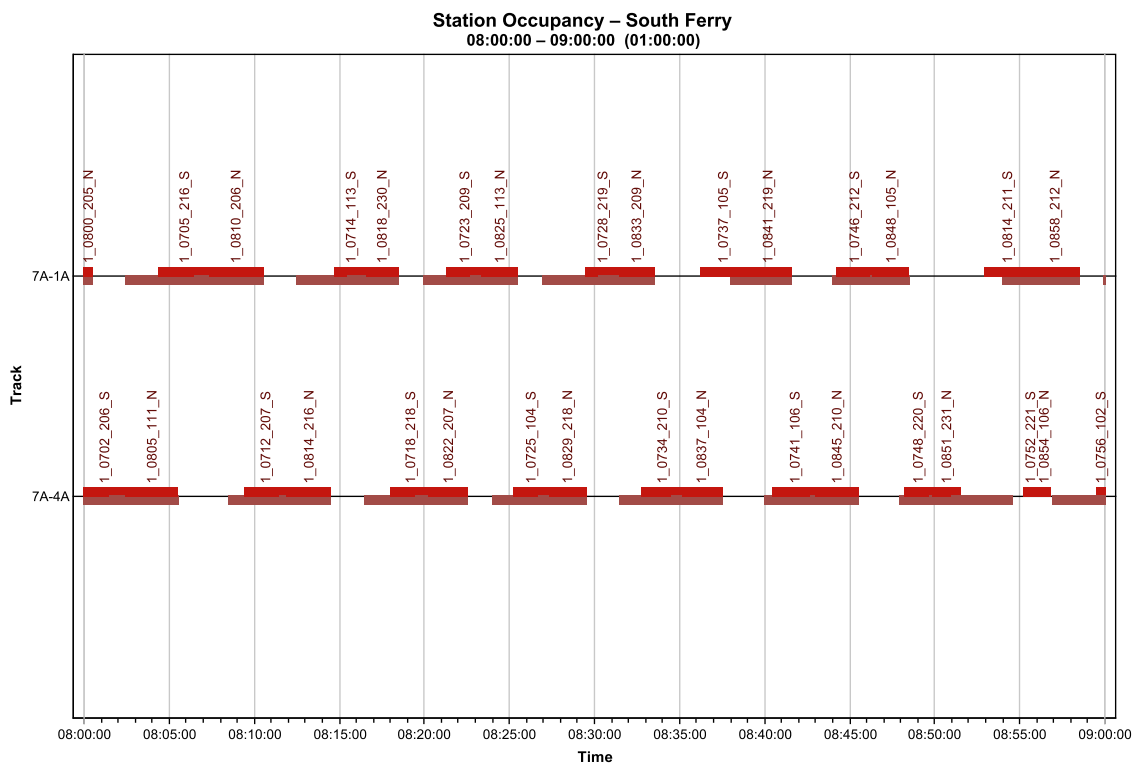


Figure F.4-83: Station Occupancy Chart – South Ferry – 8:00 to 9:00 a.m.



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Figure F.4-84: Station Occupancy Chart – South Ferry – 9:00 to 10:00 a.m.

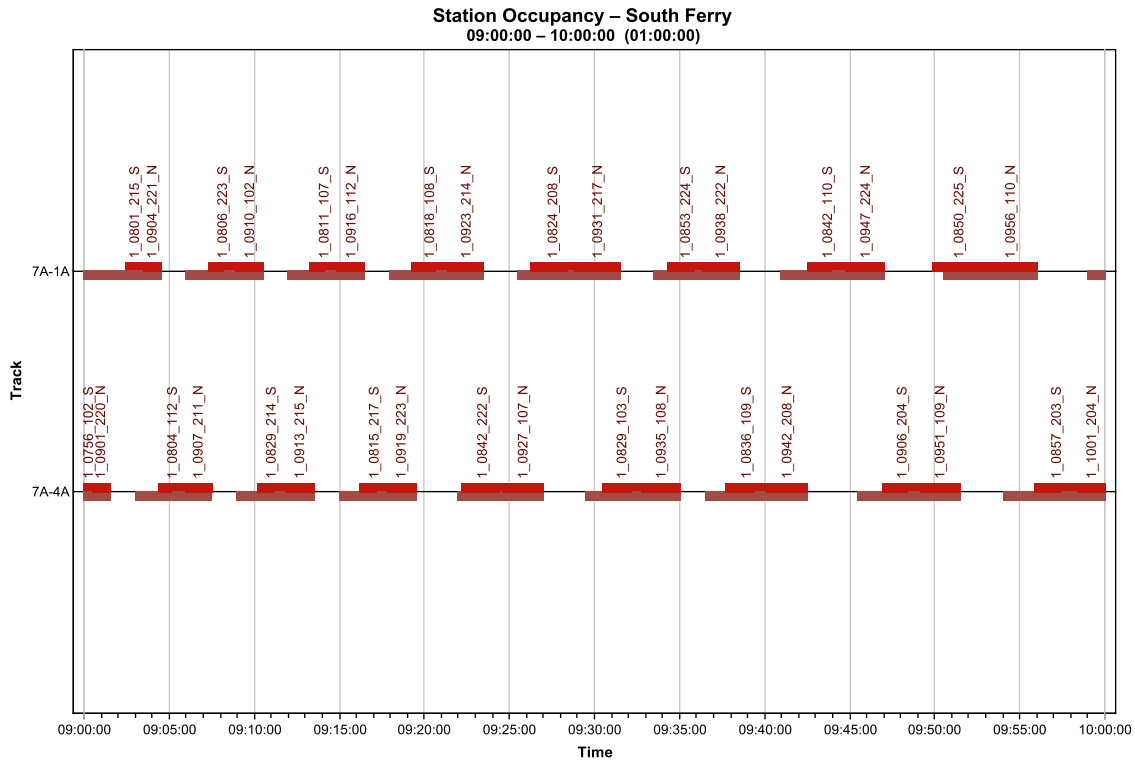
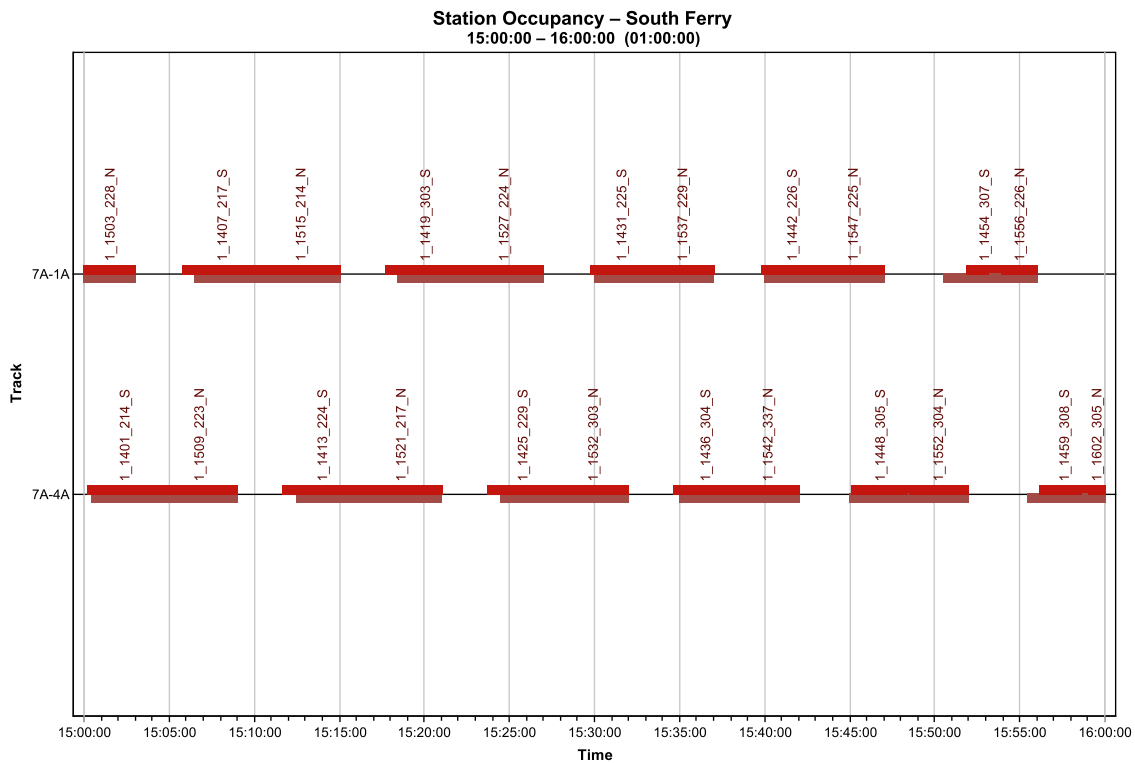


Figure F.4-85: Station Occupancy Chart – South Ferry – 3:00 to 4:00 p.m.



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Figure F.4-86: Station Occupancy Chart – South Ferry – 4:00 to 5:00 p.m.

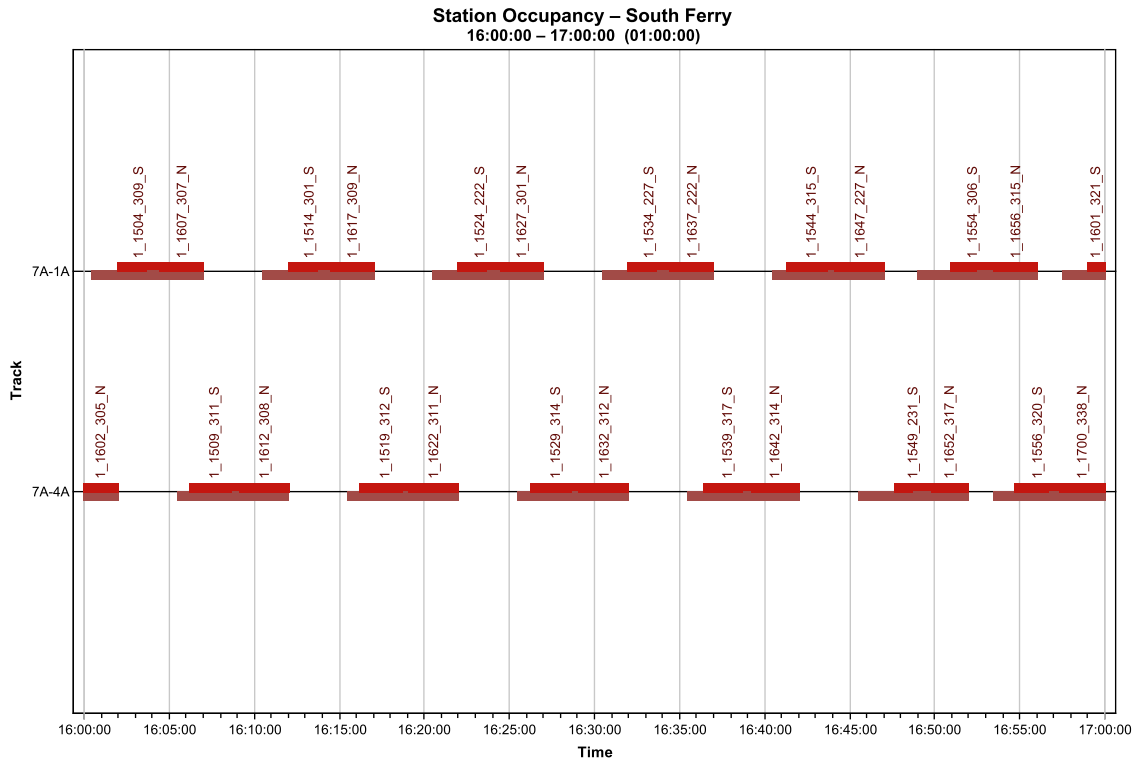
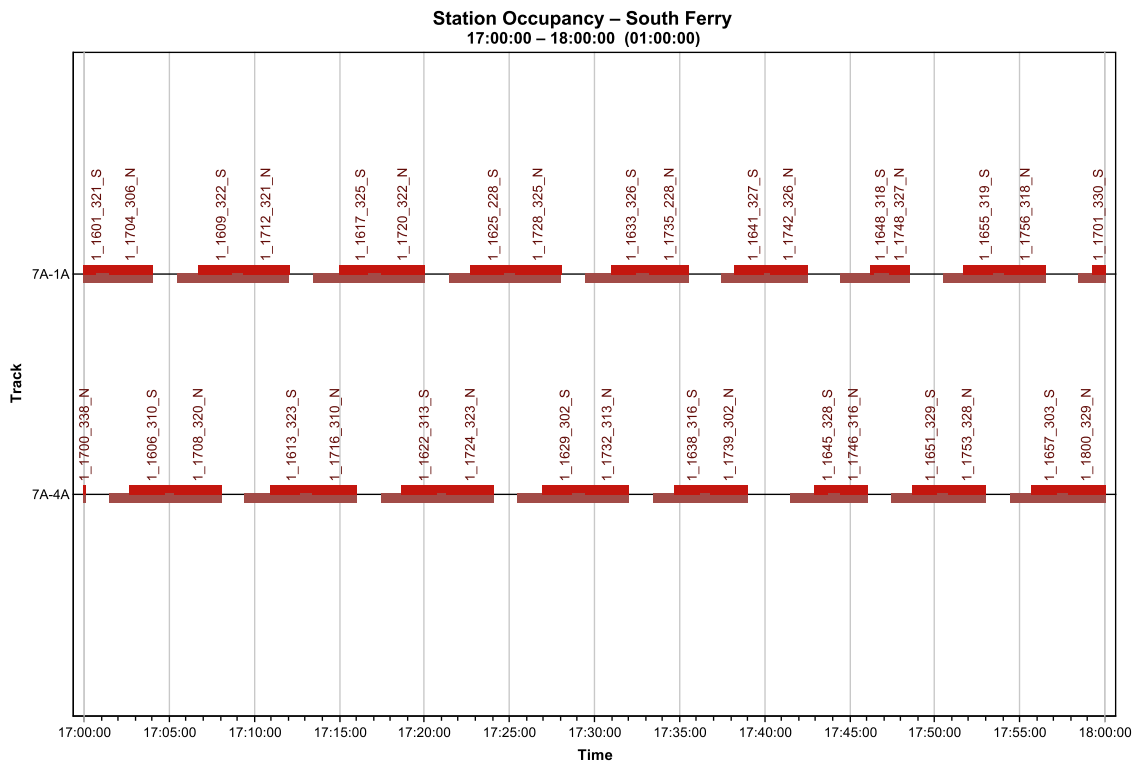
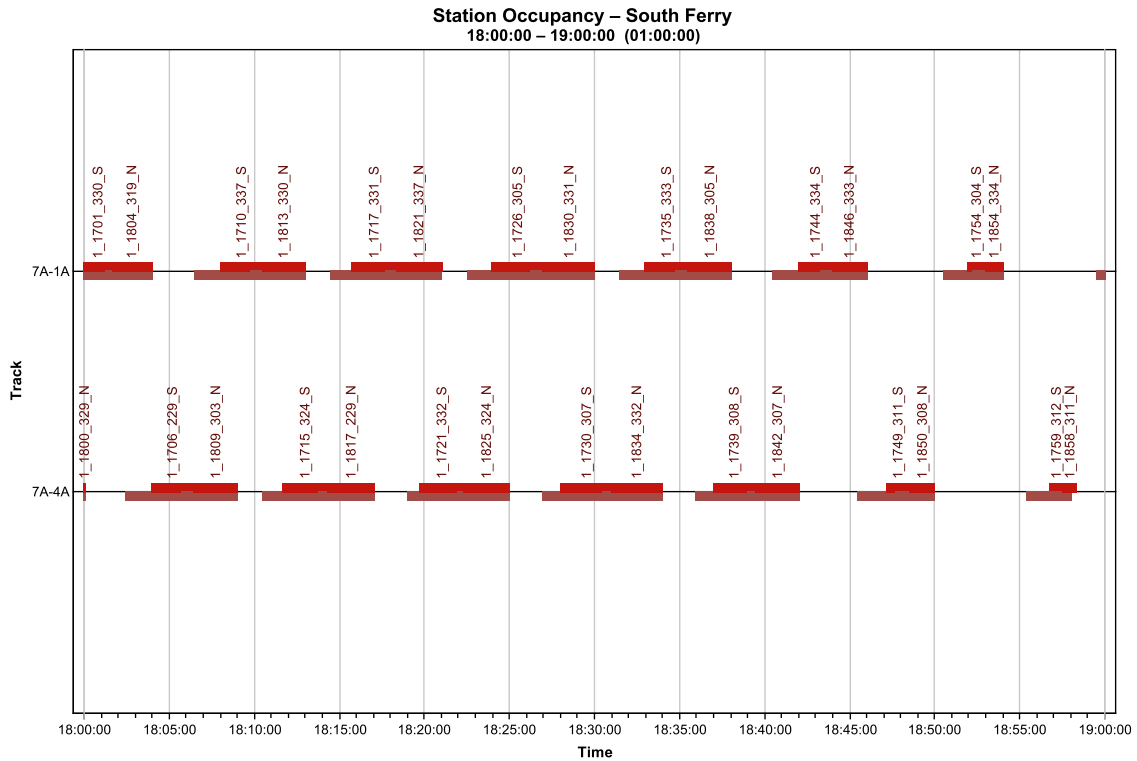


Figure F.4-87: Station Occupancy Chart – South Ferry – 5:00 to 6:00 p.m.



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Figure F.4-88: Station Occupancy Chart – South Ferry – 6:00 to 7:00 p.m.



**APPENDICES TO BASELINE WAYSIDE CALIBRATION
SIMULATION TECHNICAL MEMORANDUM**

F.5 Present and Potential Capacity Constraints: Baseline (Wayside) Model

APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Table F.5-1. Capacity Constraints, Baseline (Wayside) Model, Morning Peak

Line	Track	Direction	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity	Volume/ Capacity
Broadway	7A-1	S	Van Cortlandt Park/242 St	238 St	1	11					11	16	69%
Broadway	7A-4	N	238 St	Van Cortlandt Park/ 242 St	1	9					9	16	56%
Broadway	7A-1	S	238 St	Dyckman St	1	15					15	30	50%
Broadway	7A-4	N	Dyckman St	238 St	1	9					9	30	30%
Broadway	7A-1	S	Dyckman St	145 St	1	15					15	30	50%
Broadway	7A-4	N	145 St	Dyckman St	1	9					9	30	30%
Broadway	7A-1	S	145 St	103 St	1	18					18	30	60%
Broadway	7A-4	N	103 St	145 St	1	13					13	30	43%
Broadway	7A-1	S	103 St	Times Sq/42 St	1	18					18	25	72%
7th Avenue	7A-4	N	Times Sq/42 St	103 St	1	13					13	29	45%
7th Avenue	7A-1	S	Times Sq/42 St	Chambers St	1	18					18	25	72%
7th Avenue	7A-4	N	Chambers St	Times Sq/42 St	1	15					15	29	52%
7th Avenue	7A-1	S	Chambers St	South Ferry Terminal	1	18					18	25	72%
7th Avenue	7A-4	N	South Ferry Terminal	Chambers St	1	15					15	29	52%
Lenox Avenue	LN-1	S	Harlem/148 St	145 St	3	11					11	13	85%
Lenox Avenue	LN-4	N	145 St	Harlem/148 St	3	8					8	13	62%
Lenox Avenue	LN-1	S	145 St	142 St Jct	3	11					11	30	37%
Lenox Avenue	LN-4	N	142 St Jct	145 St	3	8					8	11	73%
Lenox Avenue	7A-2-LN-2	S	142 St Jct	Central Park North (110 St)	2 3	22					22	30	73%
Lenox Avenue	7A-3-LN-3	N	Central Park North (110 St)	142 St Jct	2 3	17					17	22	77%
Lenox Avenue	7A-2-LN-2	S	Central Park North (110 St)	103 St	2 3	22					22	23	96%
Lenox Avenue	7A-3-LN-3	N	103 St	Central Park North (110 St)	2 3	17					17	27	63%
Broadway	7A-2-LN-2	S	103 St	Times Sq/42 St	2 3	22					22	23	96%
Broadway	7A-3-LN-3	N	Times Sq/42 St	103 St	2 3	17					17	27	63%
7th Avenue	7A-2-LN-2	S	Times Sq/42 St	Chambers St	2 3	22					22	23	96%
7th Avenue	7A-3-LN-3	N	Chambers St	Times Sq/42 St	2 3	17					17	27	63%
7th Avenue	7A-2-LN-2	S	Chambers St	Park Place	2 3	22					22	28	79%
7th Avenue	7A-3-LN-3	N	Park Place	Chambers St	2 3	17					17	29	59%
Clark Street	7A-2-LN-2	S	Park Place	Fulton St	2 3	22					22	28	79%

APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Table F.5-1. Capacity Constraints, Baseline (Wayside) Model, Morning Peak

Line	Track	Direction	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity	Volume/ Capacity
Clark Street	7A-3-LN-3	N	Fulton St	Park Place	2 3	17					17	29	59%
Clark Street	7A-2-LN-2	S	Fulton St	Hoyt St	2 3	22					22	29	76%
7th Avenue	7A-3-LN-3	N	Hoyt St	Fulton St	2 3	20					20	29	69%
Eastern Parkway	EP-E1	S	Hoyt St	Franklin Av	2 3	21					21	28	75%
Eastern Parkway	EP-E4	N	Franklin Av	Hoyt St	2 3	18					18	29	62%
Eastern Parkway	EP-E1	S	Franklin Av	Nostrand Jct	2 3	20					20	24	83%
Eastern Parkway	EP-E4	N	Nostrand Jct	Franklin Av	2 3	18					18	29	62%
Eastern Parkway	EP-E1	S	Nostrand Jct	Van Siclen Av	3	10					10	30	33%
Eastern Parkway	EP-E4	N	Van Siclen Av	Nostrand Av	3	9					9	29	31%
Eastern Parkway	EP-E1	S	Van Siclen Av	New Lots Av	3	10					10	18	56%
Eastern Parkway	EP-E4	N	New Lots Av	Van Siclen Av	3	9					9	18	50%
White Plains Road	WP-2	S	Wakefield/241 St	Nereid Av	2	12					12	20	60%
White Plains Road	WP-3	N	Nereid Av	Wakefield/241 St	2	7					7	24	29%
White Plains Road	WP-2	S	Nereid Av	Bronx Park East	2	12	5	7			19	30	63%
White Plains Road	WP-3	N	Bronx Park East	Nereid Av	2	7					7	24	29%
White Plains Road	WP-2	S	Bronx Park East	E 180 St	2	12	5	7			19	30	63%
White Plains Road	WP-3	N	E 180 St	Bronx Park East	2	7					7	24	29%
Lenox Av/White Plains Rd	WP-2	S	E 180 St	West Farms Sq/ E Tremont Av	2	12					12	26	46%
Lenox Av/White Plains Rd	WP-M	S	E 180 St	West Farms Sq/ E Tremont Av	5	15					15	26	58%
Lenox Av/White Plains Rd	WP-3	N	West Farms Sq/E Tremont Av	E 180 St	2	8	5	9			17	24	71%
Lenox Av/White Plains Rd	WP-2	S	West Farms Sq/E Tremont Av	3 Av/149 St	2	12					12	26	46%
Lenox Av/White Plains Rd	WP-M	S	West Farms Sq/E Tremont Av	3 Av/149 St	5	15					15	26	58%
Lenox Av/White Plains Rd	WP-3	N	3 Av/149 St	West Farms Sq/ E Tremont Av	2	8	5	9			17	26	65%
Lenox Av	7A-2-LN-2	S	149 St/Grand Concourse	142 St Jct	2	12					12	15	80%
Lenox Av	WP-2	S	3 Av/149 St	149 St/Grand Concourse	2	12	5	15			27	19	142%
Lenox Av	WP-3	N	149 St/Grand Concourse	3 Av/149 St	2	8	5	9			17	19	89%
Lenox Av	7A-3-LN-3	N	142 St Jct	149 St/Grand Concourse	2	9					9	22	41%
Clark Street	EP-E4	N	Hoyt St	Fulton St	2	20					20	29	69%
Eastern Parkway	EP-E1	S	Nostrand Jct	Nostrand Jct	2 3	20	5	11			31	31	100%
Nostrand Avenue	NO-D2	S	Nostrand Jct	Newkirk Av	2	10	5	11			21	24	88%
Eastern Parkway	EP-E4	N	Nostrand Jct	Nostrand Jct	2	10	3	9	5	11	30	30	100%

APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Table F.5-1. Capacity Constraints, Baseline (Wayside) Model, Morning Peak

Line	Track	Direction	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity	Volume/ Capacity
Nostrand Avenue	NO-D3	N	Newkirk Av	Nostrand Jct	2	10	5	11			21	27	78%
Nostrand Avenue	NO-D2	S	Newkirk Av	Flatbush Av/Brooklyn College	2	10	5	11			21	21	100%
Nostrand Avenue	NO-D3	N	Flatbush Av/Brooklyn College	Newkirk Av	2	10	5	11			21	21	100%
Jerome Avenue	JR-1	S	Woodlawn	Mosholu Pkwy	4	15					15	20	75%
Jerome Avenue	JR-4	N	Mosholu Pkwy	Woodlawn	4	12					12	20	60%
Jerome Avenue	JR-1	S	Mosholu Pkwy	Bedford Park Blvd/Lehman College	4	15					15	20	75%
Jerome Avenue	JR-4	N	Bedford Park Blvd/Lehman College	Mosholu Pkwy	4	12					12	20	60%
Jerome Avenue	JR-1	S	Bedford Park Blvd/Lehman College	149 St/Grand Concourse	4	15					15	25	60%
Jerome Avenue	JR-4	N	149 St/Grand Concourse	Bedford Park Blvd/Lehman College	4	12					12	30	40%
Jerome Avenue	JR-1	S	149 St/Grand Concourse	138 St/Grand Concourse	4	15					15	28	54%
Jerome Avenue	LX-4-JR-4	N	North of 138 St	149 St/Grand Concourse	4	12					12	30	40%
Lexington Avenue	LX-1-JR-1	S	138 St/Grand Concourse	125 St	4 5	27					27	29	93%
Lexington Avenue	LX-4-JR-4	N	138 St/Grand Concourse	North of 138 St	4 5	23					23	30	77%
Lexington Avenue	LX-1-JR-1	S	125 St	116 St	4 5	26					26	26	100%
Lexington Avenue	LX-2-PE-2	S	116 St	110 St	4 5	26					26	26	100%
Lexington Avenue	LX-2-PE-2	S	110 St	103 St	4 5	26					26	26	100%
Lexington Avenue	LX-1-JR-1	S	103 St	51 St	4 5	26					26	26	100%
Lexington Avenue	LX-3-PE-3	N	125 St	138 St/Grand Concourse	4 5	23					23	30	77%
Lexington Avenue	LX-3-PE-3	N	51 St	125 St	4 5	23					23	25	92%
Lexington Avenue	EP-2-LX-2	S	Grand Central/42 St	14 St/Union Sq	4 5	22					22	24	92%
Lexington Avenue	LX-3-PE-3	N	Grand Central/42 St	51 St	4 5	22					22	25	88%
Lexington Avenue	EP-2-LX-2	S	14 St/Union Sq	Brooklyn Bridge	4 5	23					23	25	92%
Lexington Avenue	EP-E3-LX-3	N	14 St/Union Sq	Grand Central/42 St	4 5	23					23	25	92%
Lexington Avenue	EP-2-LX-2	S	Brooklyn Bridge	Bowling Green	4 5	25					25	30	83%
Lexington Avenue	EP-E3-LX-3	N	Brooklyn Bridge	14 St/Union Sq	4 5	22					22	28	79%
Lexington Avenue	EP-2-LX-2	S	Bowling Green	Hoyt St	4 5	24					24	26	92%

APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Table F.5-1. Capacity Constraints, Baseline (Wayside) Model, Morning Peak

Line	Track	Direction	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity	Volume/ Capacity
Eastern Parkway	EP-E3-LX-3	N	Hoyt St	Bowling Green	4 5	24					24	25	96%
Eastern Parkway	EP-2-LX-2	S	Hoyt St	Franklin Av	4 5	23					23	26	88%
Eastern Parkway	EP-E3-LX-3	N	Franklin Av	Hoyt St	4 5	22					22	25	88%
Eastern Parkway	EP-2-LX-2	S	Franklin Av	Kingston Av	4	12					12	19	63%
Eastern Parkway	EP-E3-LX-3	N	Nostrand Jct	Franklin Av	4 5	23					23	27	85%
Eastern Parkway	EP-E3-LX-3	N	Kingston Av	Nostrand Av	4	12					12	19	63%
Eastern Parkway	EP-2-LX-2	S	Kingston Av	Crown Hts/Utica Av	4	12					12	17	71%
Eastern Parkway	EP-E3-LX-3	N	Crown Hts/Utica Av	Kingston Av	4	12					12	17	71%
Dyre Avenue	DY-1	S	Eastchester/Dyre Av	Baychester Av	5	8					8	18	44%
Dyre Avenue	DY-2	N	Baychester Av	Eastchester/Dyre Av	5	7					7	18	39%
Dyre Avenue	DY-1	S	Baychester Av	Morris Park	5	8					8	21	38%
Dyre Avenue	DY-2	N	Morris Park	Baychester Av	5	7					7	24	29%
Dyre Avenue	DY-1	S	Morris Park	E 180 St	5	8					8	26	31%
Dyre Avenue	DY-2	N	E 180 St	Morris Park	5	7					7	24	29%
Dyre Avenue	WP-1A	S	149 St/ Grand Concourse	North of 138 St	5	14					14	19	74%
Dyre Avenue	WP-4A	N	138 St/Grand Concourse	149 St/Grand Concourse	5	10					10	19	53%
Lexington Avenue	LX-1-JR-1	S	North of 138 St	138 St/Grand Concourse	5	14					14	28	50%
Lexington Avenue	EP-E3-LX-3	N	125 St	138 St/Grand Concourse	4 5	23					23	30	77%
Lexington Avenue	LX-1-JR-1	S	125 St	110 St	4 5	26					26	26	100%
Lexington Avenue	LX-2-PE-2	S	103 St	51 St	4 5	26					26	26	100%
Lexington Avenue	EP-2-LX-2	S	51 St	Grand Central/42 St	4 5	23					23	26	88%
Lexington Avenue	EP-E3-LX-3	N	Grand Central/42 St	51 St	4 5	22					22	25	88%
Lexington Avenue	EP-E3-LX-3	N	Bowling Green	Brooklyn Bridge	4 5	24					24	30	80%
Eastern Parkway	EP-2-LX-2	S	Franklin Av	Nostrand Jct	4 5	23					23	24	96%
Pelham	PE-2	S	Pelham Bay Park	Westchester Sq/ E Tremont Av	6	10					10	20	50%

APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Table F.5-1. Capacity Constraints, Baseline (Wayside) Model, Morning Peak

Line	Track	Direction	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity	Volume/ Capacity
Pelham	PE-3	N	Westchester Sq/ E Tremont Av	Pelham Bay Park	6	10					10	20	50%
Pelham	PE-2	S	Westchester Sq/ E Tremont Av	Castle Hill Av	6	10					10	30	33%
Pelham	PE-3	N	Castle Hill Av	Westchester Sq/ E Tremont Av	6	14					14	30	47%
Pelham	PE-M	S	Westchester Sq/ E Tremont Av	Castle Hill Av	6	10					10	23	43%
Pelham	PE-2	S	Castle Hill Av	Brook Av	6	10					10	23	43%
Pelham	PE-3	N	Brook Av	Castle Hill Av	6	17					17	27	63%
Pelham	PE-M	S	Castle Hill Av	Brook Av	6	10					10	23	43%
Pelham	PE-2	S	Brook Av	3 Av/138 St	6	10					10	30	33%
Pelham	PE-3	N	3 Av/138 St	Brook Av	6	17					17	23	74%
Pelham	PE-M	S	Brook Av	3 Av/138 St	6	10					10	23	43%
Lexington Avenue	LX-2-PE-2	S	3 Av/138 St	125 St	6	20					20	30	67%
Lexington Avenue	LX-3A-125	N	125 St	3 Av/138 St	6	17					17	30	57%
Lexington Avenue	LX-1-JR-1	S	125 St	116 St	6	20					20	30	67%
Lexington Avenue	LX-1-JR-1	S	116 St	51 St	6	20					20	26	77%
Lexington Avenue	LX-4-JR-4	N	51 St	125 St	6	17					17	30	57%
Lexington Avenue	LX-1-JR-1	S	51 St	Grand Central/42 St	6	20					20	27	74%
Lexington Avenue	LX-4-JR-4	N	Grand Central/42 St	51 St	6	17					17	27	63%
Lexington Avenue	LX-1-JR-1	S	Grand Central/42 St	Grand Central South Interlocking	6	20					20	27	74%
Lexington Avenue	LX-4-JR-4	N	14 St/Union Sq	Grand Central/42 St	6	17					17	27	63%
Lexington Avenue	LX-1-JR-1	S	Grand Central South Interlocking	14 St/Union Sq	6	19					19	27	70%
Lexington Avenue	LX-1-JR-1	S	14 St/Union Sq	Brooklyn Bridge	6	19					19	23	83%
Lexington Avenue	LX-4-JR-4	N	Brooklyn Bridge	14 St/Union Sq	6	17					17	26	65%
Lexington Avenue	LX-4-JR-4	S/N	Brooklyn Bridge South	Brooklyn Bridge North	6	18					18	30	60%
42nd Street Shuttle	42-S-1	S/N	Times Sq Shuttle	Grand Central Shuttle	S	10					10	10	100%
42nd Street Shuttle	42-S-4	S/N	Times Sq Shuttle	Grand Central Shuttle	S	10					10	10	100%

Notes:

- Capacity is shown on a segment-specific basis. Available capacity may not be usable given constraints elsewhere in the network for a given service.
- Times Sq-Grand Central service delivery and capacity reflect one-way operation. Bidirectional service delivery on each track is double the train volumes shown.

APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Table F.5-2. Capacity Constraints, Baseline (Wayside) Model, Evening Peak

Line	Track	Direction	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity	Volume/ Capacity
Broadway	7A-1	S	Van Cortlandt Park/242 St	238 St	1	14					14	16	88%
Broadway	7A-4	N	238 St	Van Cortlandt Park/ 242 St	1	16					16	16	100%
Broadway	7A-1	S	238 St	Dyckman St	1	16					16	30	53%
Broadway	7A-4	N	Dyckman St	238 St	1	16					16	30	53%
Broadway	7A-1	S	Dyckman St	145 St	1	16					16	30	53%
Broadway	7A-4	N	145 St	Dyckman St	1	16					16	30	53%
Broadway	7A-1	S	145 St	103 St	1	16					16	30	53%
Broadway	7A-4	N	103 St	145 St	1	16					16	30	53%
Broadway	7A-1	S	103 St	Times Sq/42 St	1	16					16	25	64%
7th Avenue	7A-4	N	Times Sq/42 St	103 St	1	16					16	29	55%
7th Avenue	7A-1	S	Times Sq/42 St	Chambers St	1	16					16	25	64%
7th Avenue	7A-4	N	Chambers St	Times Sq/42 St	1	16					16	29	55%
7th Avenue	7A-1	S	Chambers St	South Ferry Terminal	1	16					16	25	64%
7th Avenue	7A-4	N	South Ferry Terminal	Chambers St	1	16					16	29	55%
Lenox Avenue	LN-1	S	Harlem/148 St	145 St	3	9					9	13	69%
Lenox Avenue	LN-4	N	145 St	Harlem/148 St	3	11					11	13	85%
Lenox Avenue	LN-1	S	145 St	142 St Jct	3	9					9	30	30%
Lenox Avenue	LN-4	N	142 St Jct	145 St	3	11					11	11	100%
Lenox Avenue	7A-2-LN-2	S	142 St Jct	Central Park North (110 St)	2 3	18					18	30	60%
Lenox Avenue	7A-3-LN-3	N	Central Park North (110 St)	142 St Jct	2 3	22					22	22	100%
Lenox Avenue	7A-2-LN-2	S	Central Park North (110 St)	103 St	2 3	18					18	23	78%
Lenox Avenue	7A-3-LN-3	N	103 St	Central Park North (110 St)	2 3	22					22	27	81%
Broadway	7A-2-LN-2	S	103 St	Times Sq/42 St	2 3	18					18	23	78%
Broadway	7A-3-LN-3	N	Times Sq/42 St	103 St	2 3	22					22	27	81%
7th Avenue	7A-2-LN-2	S	Times Sq/42 St	Chambers St	2 3	18					18	23	78%
7th Avenue	7A-3-LN-3	N	Chambers St	Times Sq/42 St	2 3	22					22	27	81%
7th Avenue	7A-2-LN-2	S	Chambers St	Park Place	2 3	18					18	28	64%
7th Avenue	7A-3-LN-3	N	Park Place	Chambers St	2 3	22					22	29	76%
Clark Street	7A-2-LN-2	S	Park Place	Fulton St	2 3	18					18	28	64%

APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Table F.5-2. Capacity Constraints, Baseline (Wayside) Model, Evening Peak

Line	Track	Direction	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity	Volume/ Capacity
Clark Street	7A-3-LN-3	N	Fulton St	Park Place	2 3	22					22	29	76%
Clark Street	7A-2-LN-2	S	Fulton St	Hoyt St	2 3	18					18	29	62%
7th Avenue	7A-3-LN-3	N	Hoyt St	Fulton St	2 3	22					22	29	76%
Eastern Parkway	EP-E1	S	Hoyt St	Franklin Av	2 3	18					18	28	64%
Eastern Parkway	EP-E4	N	Franklin Av	Hoyt St	2 3	22					22	29	76%
Eastern Parkway	EP-E1	S	Franklin Av	Nostrand Jct	2 3	18					18	24	75%
Eastern Parkway	EP-E4	N	Nostrand Jct	Franklin Av	2 3	22					22	29	76%
Eastern Parkway	EP-E1	S	Nostrand Jct	Van Siclen Av	3	9					9	30	30%
Eastern Parkway	EP-E4	N	Van Siclen Av	Nostrand Av	3	11					11	29	38%
Eastern Parkway	EP-E1	S	Van Siclen Av	New Lots Av	3	9					9	18	50%
Eastern Parkway	EP-E4	N	New Lots Av	Van Siclen Av	3	11					11	18	61%
White Plains Road	WP-2	S	Wakefield/241 St	Nereid Av	2	11					11	20	55%
White Plains Road	WP-3	N	Nereid Av	Wakefield/241 St	2	11					11	24	46%
White Plains Road	WP-2	S	Nereid Av	Bronx Park East	2	11					11	30	37%
White Plains Road	WP-3	N	Bronx Park East	Nereid Av	2	11	5	7			18	24	75%
White Plains Road	WP-2	S	Bronx Park East	E 180 St	2	11	5	14			25	30	83%
White Plains Road	WP-3	N	E 180 St	Bronx Park East	2	11					11	24	46%
Lenox Av/White Plains Rd	WP-2	S	E 180 St	West Farms Sq/ E Tremont Av	2	9	5	14			23	26	88%
White Plains Road	WP-M	N	E 180 St	Bronx Park East	2	7					7	26	27%
Lenox Av/White Plains Rd	WP-M	N	West Farms Sq/E Tremont Av	E 180 St	5	14					14	26	54%
Lenox Av/White Plains Rd	WP-3	N	West Farms Sq/E Tremont Av	E 180 St	2	11					11	24	46%
Lenox Av/White Plains Rd	WP-2	S	West Farms Sq/E Tremont Av	3 Av/149 St	2	9	5	14			23	26	88%
Lenox Av/White Plains Rd	WP-M	N	3 Av/149 St	West Farms Sq/ E Tremont Av	5	14					14	26	54%
Lenox Av/White Plains Rd	WP-3	N	3 Av/149 St	West Farms Sq/ E Tremont Av	2	11					11	26	42%
Lenox Av	7A-2-LN-2	S	149 St/Grand Concourse	142 St Jct	2	9					9	15	60%
Lenox Av	WP-2	S	3 Av/149 St	149 St/Grand Concourse	2	13					13	19	68%
Lenox Av	WP-3	N	149 St/Grand Concourse	3 Av/149 St	2	11	5	9			20	19	105%
Lenox Av	7A-3-LN-3	N	142 St Jct	149 St/Grand Concourse	2	11					11	22	50%
Clark Street	EP-E4	N	Hoyt St	Fulton St	2	22					22	29	76%
Eastern Parkway	EP-E1	S	Nostrand Jct	Nostrand Jct	2	10	5	11	3	9	30	31	97%
Nostrand Avenue	NO-D2	S	Nostrand Jct	Newkirk Av	2	10	5	11			21	24	88%

APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Table F.5-2. Capacity Constraints, Baseline (Wayside) Model, Evening Peak

Line	Track	Direction	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity	Volume/ Capacity
Eastern Parkway	EP-E4	N	Nostrand Jct	Nostrand Jct	2	11	3	11	5	12	34	30	113%
Nostrand Avenue	NO-D3	N	Newkirk Av	Nostrand Jct	2	11	5	12			23	27	85%
Nostrand Avenue	NO-D2	S	Newkirk Av	Flatbush Av/Brooklyn College	2	10	5	11			21	21	100%
Nostrand Avenue	NO-D3	N	Flatbush Av/Brooklyn College	Newkirk Av	2	11	5	12			23	21	110%
Jerome Avenue	JR-1	S	Woodlawn	Mosholu Pkwy	4	14					14	20	70%
Jerome Avenue	JR-4	N	Mosholu Pkwy	Woodlawn	4	14					14	20	70%
Jerome Avenue	JR-1	S	Mosholu Pkwy	Bedford Park Blvd/Lehman College	4	14					14	20	70%
Jerome Avenue	JR-4	N	Bedford Park Blvd/Lehman College	Mosholu Pkwy	4	14					14	20	70%
Jerome Avenue	JR-1	S	Bedford Park Blvd/Lehman College	149 St/Grand Concourse	4	14					14	25	56%
Jerome Avenue	JR-4	N	149 St/Grand Concourse	Bedford Park Blvd/Lehman College	4	14					14	30	47%
Jerome Avenue	JR-1	S	149 St/Grand Concourse	138 St/Grand Concourse	4	14					14	28	50%
Jerome Avenue	LX-4-JR-4	N	North of 138 St	149 St/Grand Concourse	4	14					14	30	47%
Lexington Avenue	LX-1-JR-1	S	138 St/Grand Concourse	125 St	4 5	26					26	29	90%
Lexington Avenue	LX-4-JR-4	N	138 St/Grand Concourse	North of 138 St	4 5	26					26	30	87%
Lexington Avenue	LX-1-JR-1	S	125 St	116 St	4 5	26					26	26	100%
Lexington Avenue	LX-2-PE-2	S	116 St	110 St	4 5	26					26	26	100%
Lexington Avenue	LX-2-PE-2	S	110 St	103 St	4 5	26					26	26	100%
Lexington Avenue	LX-1-JR-1	S	103 St	51 St	4 5	26					26	26	100%
Lexington Avenue	LX-3-PE-3	N	125 St	138 St/Grand Concourse	4 5	26					26	30	87%
Lexington Avenue	LX-1-JR-1	S	51 St	Grand Central/42 St	4 5	18					18	26	69%
Lexington Avenue	LX-3-PE-3	N	51 St	125 St	4 5	26					26	25	104%
Lexington Avenue	EP-2-LX-2	S	Grand Central/42 St	14 St/Union Sq	4 5	26					26	24	108%
Lexington Avenue	LX-3-PE-3	N	Grand Central/42 St	51 St	4 5	26					26	25	104%
Lexington Avenue	EP-2-LX-2	S	14 St/Union Sq	Brooklyn Bridge	4 5	26					26	25	104%
Lexington Avenue	EP-E3-LX-3	N	14 St/Union Sq	Grand Central/42 St	4 5	26					26	25	104%
Lexington Avenue	EP-2-LX-2	S	Brooklyn Bridge	Bowling Green	4 5	26					26	30	87%
Lexington Avenue	EP-E3-LX-3	N	Brooklyn Bridge	14 St/Union Sq	4 5	26					26	28	93%
Lexington Avenue	EP-2-LX-2	S	Bowling Green	Hoyt St	4 5	24					24	26	92%
Eastern Parkway	EP-E3-LX-3	N	Hoyt St	Bowling Green	4 5	25					25	25	100%
Eastern Parkway	EP-2-LX-2	S	Hoyt St	Franklin Av	4 5	24					24	26	92%

APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Table F.5-2. Capacity Constraints, Baseline (Wayside) Model, Evening Peak

Line	Track	Direction	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity	Volume/ Capacity
Eastern Parkway	EP-E3-LX-3	N	Franklin Av	Hoyt St	4 5	25					25	25	100%
Eastern Parkway	EP-2-LX-2	S	Franklin Av	Kingston Av	4	14					14	19	74%
Eastern Parkway	EP-E3-LX-3	N	Nostrand Jct	Franklin Av	4 5	25					25	27	93%
Eastern Parkway	EP-E3-LX-3	N	Kingston Av	Nostrand Av	4	14					14	19	74%
Eastern Parkway	EP-2-LX-2	S	Kingston Av	Crown Hts/Utica Av	4	14					14	17	82%
Eastern Parkway	EP-E3-LX-3	N	Crown Hts/Utica Av	Kingston Av	4	14					14	17	82%
Dyre Avenue	DY-1	S	Eastchester/Dyre Av	Baychester Av	5	11					11	18	61%
Dyre Avenue	DY-2	N	Baychester Av	Eastchester/Dyre Av	5	9					9	18	50%
Dyre Avenue	DY-1	S	Baychester Av	Morris Park	5	11					11	21	52%
Dyre Avenue	DY-2	N	Morris Park	Baychester Av	5	9					9	24	38%
Dyre Avenue	DY-1	S	Morris Park	E 180 St	5	11					11	26	42%
Dyre Avenue	DY-2	N	E 180 St	Morris Park	5	9					9	24	38%
Dyre Avenue	WP-1A	S	149 St/ Grand Concourse	North of 138 St	5	13					13	19	68%
Dyre Avenue	WP-4A	N	138 St/Grand Concourse	149 St/Grand Concourse	5	14					14	19	74%
Lexington Avenue	LX-1-JR-1	S	North of 138 St	138 St/Grand Concourse	5	13					13	28	46%
Lexington Avenue	LX-1-JR-1	S	125 St	110 St	4 5	26					26	26	100%
Lexington Avenue	LX-2-PE-2	S	103 St	51 St	4 5	26					26	26	100%
Lexington Avenue	EP-2-LX-2	S	51 St	Grand Central/42 St	4 5	26					26	26	100%
Lexington Avenue	EP-E3-LX-3	N	Bowling Green	Brooklyn Bridge	4 5	26					26	30	87%
Eastern Parkway	EP-2-LX-2	S	Franklin Av	Nostrand Jct	4 5	24					24	24	100%
Pelham	PE-2	S	Pelham Bay Park	Westchester Sq/ E Tremont Av	6	10					10	20	50%
Pelham	PE-3	N	Westchester Sq/ E Tremont Av	Pelham Bay Park	6	11					11	20	55%
Pelham	PE-2	S	Westchester Sq/ E Tremont Av	Castle Hill Av	6	18					18	30	60%
Pelham	PE-3	N	Castle Hill Av	Westchester Sq/ E Tremont Av	6	9					9	30	30%
Pelham	PE-M	S	Westchester Sq/ E Tremont Av	Castle Hill Av	6	9					9	23	39%
Pelham	PE-2	S	Castle Hill Av	Brook Av	6	18					18	23	78%
Pelham	PE-3	N	Brook Av	Castle Hill Av	6	9					9	27	33%
Pelham	PE-M	S	Castle Hill Av	Brook Av	6	9					9	23	39%
Pelham	PE-2	S	Brook Av	3 Av/138 St	6	18					18	30	60%
Pelham	PE-3	N	3 Av/138 St	Brook Av	6	9					9	23	39%
Pelham	PE-M	S	Brook Av	3 Av/138 St	6	9					9	23	39%

APPENDICES TO BASELINE WAYSIDE CALIBRATION SIMULATION TECHNICAL MEMORANDUM

Table F.5-2. Capacity Constraints, Baseline (Wayside) Model, Evening Peak

Line	Track	Direction	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity	Volume/ Capacity
Lexington Avenue	LX-2-PE-2	S	3 Av/138 St	125 St	6	18					18	30	60%
Lexington Avenue	LX-3A-125	N	125 St	3 Av/138 St	6	18					18	30	60%
Lexington Avenue	LX-1-JR-1	S	125 St	116 St	6	18					18	30	60%
Lexington Avenue	LX-1-JR-1	S	116 St	51 St	6	18					18	26	69%
Lexington Avenue	LX-4-JR-4	N	51 St	125 St	6	18					18	30	60%
Lexington Avenue	LX-1-JR-1	S	51 St	Grand Central/42 St	6	18					18	27	67%
Lexington Avenue	LX-4-JR-4	N	Grand Central/42 St	51 St	6	18					18	27	67%
Lexington Avenue	LX-1-JR-1	S	Grand Central/42 St	Grand Central South Interlocking	6	18					18	27	67%
Lexington Avenue	LX-4-JR-4	N	14 St/Union Sq	Grand Central/42 St	6	18					18	27	67%
Lexington Avenue	LX-1-JR-1	S	Grand Central South Interlocking	14 St/Union Sq	6	18					18	27	67%
Lexington Avenue	LX-1-JR-1	S	14 St/Union Sq	Brooklyn Bridge	6	18					18	23	78%
Lexington Avenue	LX-4-JR-4	N	Brooklyn Bridge	14 St/Union Sq	6	18					18	26	69%
Lexington Avenue	LX-4-JR-4	S/N	Brooklyn Bridge South	Brooklyn Bridge North	6	18					18	30	60%
42nd Street Shuttle	42-S-1	S/N	Times Sq Shuttle	Grand Central Shuttle	S	10					10	10	100%
42nd Street Shuttle	42-S-4	S/N	Times Sq Shuttle	Grand Central Shuttle	S	10					10	10	100%
Lenox Av/White Plains Rd	WP-M	N	E 180 St	Bronx Park East	5	14					14	26	54%
White Plains Road	WP-3	N	E 180 St	Bronx Park East (top of segment)	2	11	5	7			18	24	75%
White Plains Road	WP-3	N	E 180 St	Bronx Park East (middle of segment)	2	11	5	9			20	24	83%

Notes:

- Capacity is shown on a segment-specific basis. Available capacity may not be usable given constraints elsewhere in the network for a given service.
- Times Sq-Grand Central service delivery and capacity reflect one-way operation. Bidirectional service delivery on each track is double the train volumes shown.



IRT CAPACITY STUDY

1 2 3 4 5 6 S LINES

G - APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM



Prepared for:



***by:
STV
July 2020***

**APPENDICES TO FUTURE BASELINE (CBTC)
TECHNICAL MEMORANDUM**

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APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

G.0 Revision History – Not Applicable

G.1 Input Data, Assumptions, and Methodology

G.1.1 Rolling Stock

The CBTC simulations are based on R188 vehicle performance under high rate (CBTC mode) acceleration. The older R62/R62A fleet is not compatible with CBTC ATO operation and will be limited to lines without CBTC until retirement. The R142/R142A fleet is not “CBTC ready” but NYCT is planning midlife overhauls that will enable these cars to operate under CBTC. The R142 fleet (1,030 cars) is planned for overhaul from 2020 to 2024. The R142A fleet (220 cars) is planned for overhaul from 2020 to 2021. It is assumed that their resultant performance under CBTC will be virtually the same as that of the R188 fleet under high rate (CBTC mode) acceleration.

G.1.1.1 *Physical and Performance Characteristics*

Table G.1-1 compares the Kawasaki R188 performance with the R62/R62A and R142/R142A cars used in the A-Division wayside signaling simulations. Additional figures in this section show the per-car tractive effort/propulsion current (AW2) and braking effort curves (AW3). The braking effort curves show total per-car braking effort, along with a sub-division separating electrical (dynamic/regenerative) braking from friction braking. In general, most of the braking effort of these vehicle types is achieved through dynamic/regenerative braking. For all vehicle type the mechanical resistance was modeled using Davis Coefficients and train resistance formula:

$$TR = 1.3W + 29n + 0.045WV + [0.0024 + 0.00034(Q - 1)]AV^2, \text{ where:}$$

TR = Total train resistance in pounds force

W = Total train weight in tons

n = number of axles in the train

V = Train speed in miles per hour

A = Frontal area in square feet

Q = Number of cars in the train

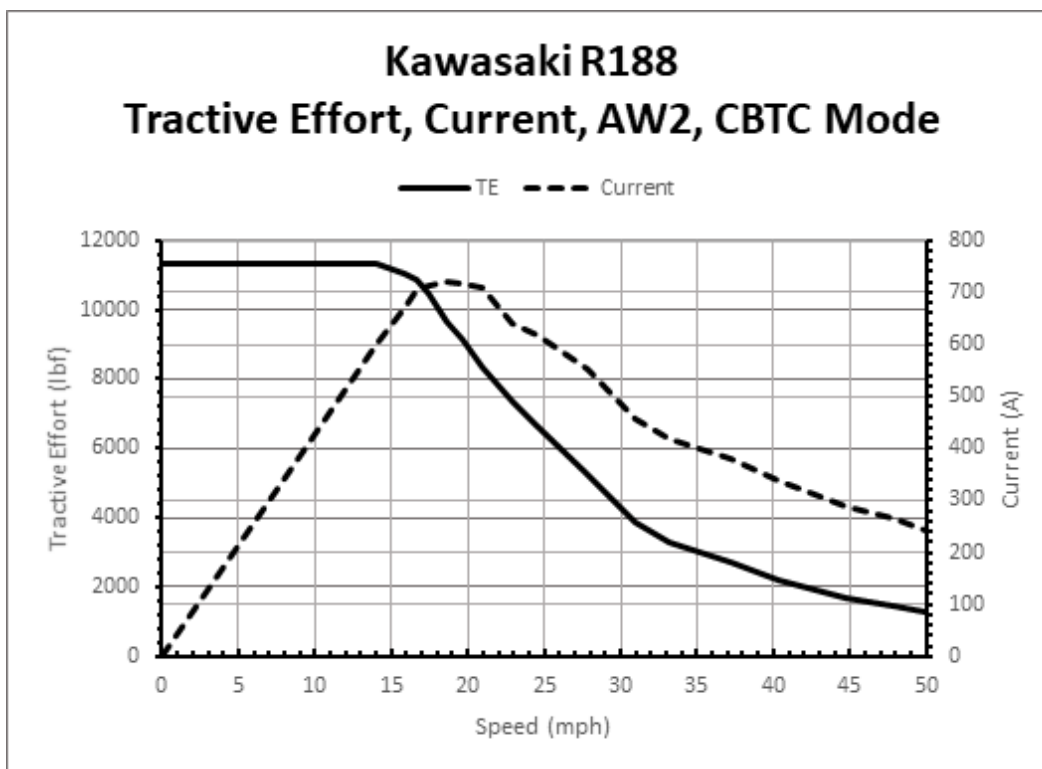
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.1-1. A-Division Rolling Stock Characteristics for Simulation

Model	Bombardier R62/R62A	Bombardier/ Kawasaki R142/R142A	Kawasaki R188
Length (feet)	51.05	51.3	51
Weight (pounds) – AW0	74,593	71,964	70,527
Passenger Capacity (Seated)	44	37	37
Passenger Capacity (Total) – AW3	182	182	183
Number of Axles	4	4	4
Maximum Operating Speed (mph)	50	50	50
Nominal Acceleration (mph/s)	2.5	2.5	2.5
Service Brake Rate (mph/s)	3.0	3.0	3.0
Rotational Mass (%)	8.0	8.0	8.0
Frontal Area (ft ²)	100	102	102

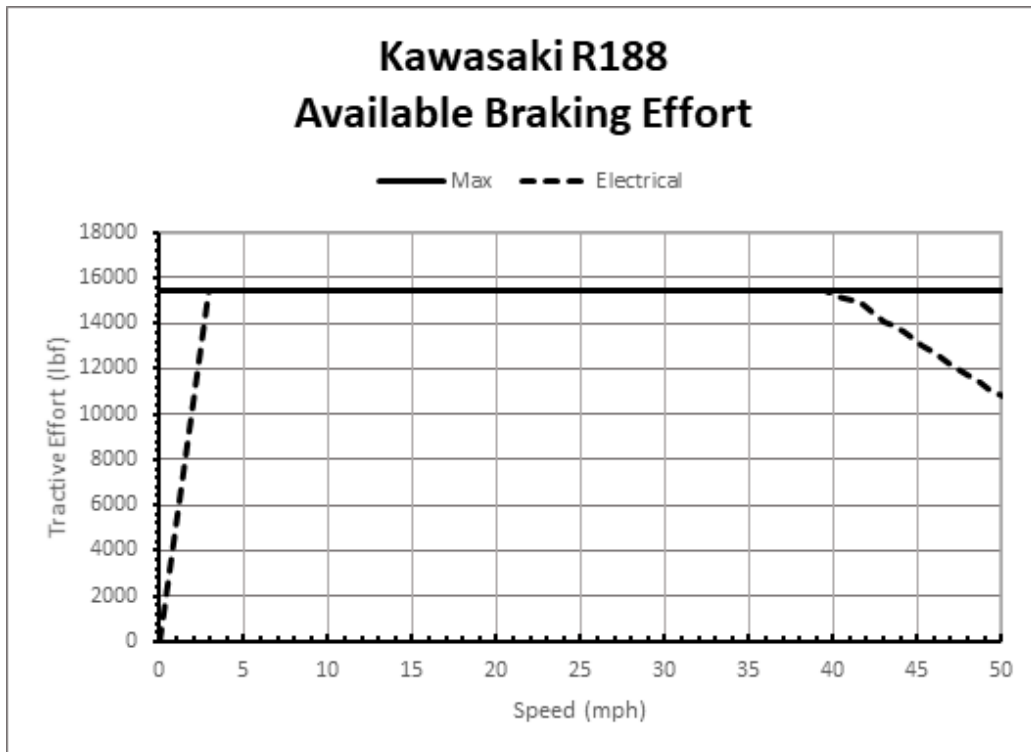
Please note that the Nominal Acceleration value is not indicative of overall time to attain maximum speed.

Figure G.1-1: TE/Current for R188 Model at AW2, CBTC Mode



APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.1-2: BE for R188 Model at AW3, CBTC Mode



G.1.2 Infrastructure

Track alignment includes vertical profile (grades), horizontal alignment (curves), and points of switch. It also includes the underlying stationing/chainage system with associated equations (“equalities”) to account for disconnects in continuous stationing/chainage. Maximum operating speeds, which differ in terms of existing and CBTC operations, are also described below. These speeds differ because many speeds today are artificially constrained due to limited signal design braking distance ahead (requiring enforced speed restrictions to limit attainable speed with attendant reduction in required braking distance) and the intermittent nature of NYCT’s current speed enforcement technologies.

G.1.2.1 Grades and Curves

Vertical profile (grades) and horizontal alignment (curves) are unchanged from the wayside signaling simulation model.

G.1.2.2 Points of Switch

Points of switch are unchanged from the wayside signaling simulation model.

G.1.2.3 Chainage Equations (Equalities)

Chainage equations are unchanged from the wayside signaling simulation model.

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G.1.2.4 Platform Limits

Station platform limits and configurations (island versus side layout) are unchanged from the wayside signaling simulation model.

G.1.2.5 Communications-Based Train Control Speeds

NYCT provided CBTC criteria for curve and diverging switch speeds, as shown in Table G.1-2. NYCT CPM Signals and MOW Engineering agreed that the Normal Average Operating Speed was too conservative as a regular curve speed limit. Instead, it was agreed that maximum speed of $V4 + 1/3 (V6-V4)$ should be used.

**Table G.1-2. Summary of NYCT CBTC Speed Policy Standards for
Curves and Turnouts**

	Normal Average Operating Speed	Normal High Operating Speed Limit	Not-To-Exceed Speed (Safe Speed Absolute Limit)
Regular Curves	V4	V6	V11
Standard AREMA Turnouts	V1.5	V6	V9
Tangential NYCT Turnouts	V3	V6	V9

As an example, the sharp curve between Saratoga and Sutter Avenue - Rutland Road Stations on the New Lots Avenue Line is presently controlled by GT20 signals. The curve has a tight 296-foot radius and 4.46 inches of actual super-elevation. A review of event recorder data shows three trips traversing the curve with average speeds of about 15, 18 and 20 MPH. Under CBTC, the curve will support a V4 (Normal Average Operating Speed) of 25 MPH and a V6 (Normal High Operating Speed Limit) of 28 MPH. The simulated CBTC limit will be 26 MPH based on the direction from NYCT MOW Engineering and CPM Signals to apply a maximum speed as one-third of the span between the two computed speeds. With assumed speedometer error, the typical ATO train should traverse the curve at about 25 MPH, a significant improvement versus today's speed.

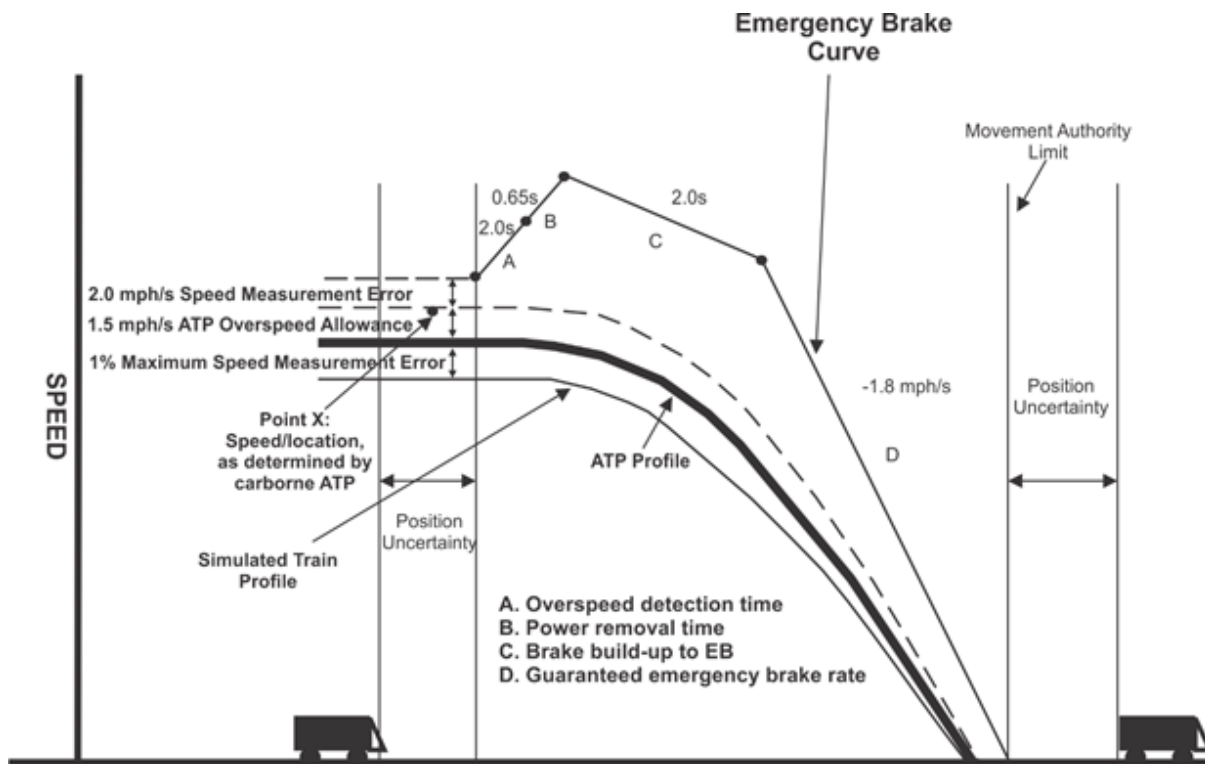
Table G.1-3 shows the CBTC speeds for standard NYCT turnouts of varying frog angles. The V9 speeds shown in Table G.1-3 are for reference only.

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.1-3. CBTC Speeds for Standard Turnouts

Turnout No. (Frog Angle)	Radius (ft.)	Comfort Speed (mph)		V6 Speed (mph)	V9 Speed (mph)
		Standard AREMA	Tangential		
3.5	120	7	N.A.	13	16
4	151	7.5	11	15	18
4.5	191	8	N.A.	17	21
5	235	9	13	19	23
6	339	11	16	22.5	27
7	461	13	18.5	26	32
8	603	15	21	30	37
9	763	17	24	34	41
10	942	19	26.5	37.5	46
11	1139	21	29	41	51
12	1356	22.5	32	45	55

Figure G.1-3: CBTC Safe Braking Model

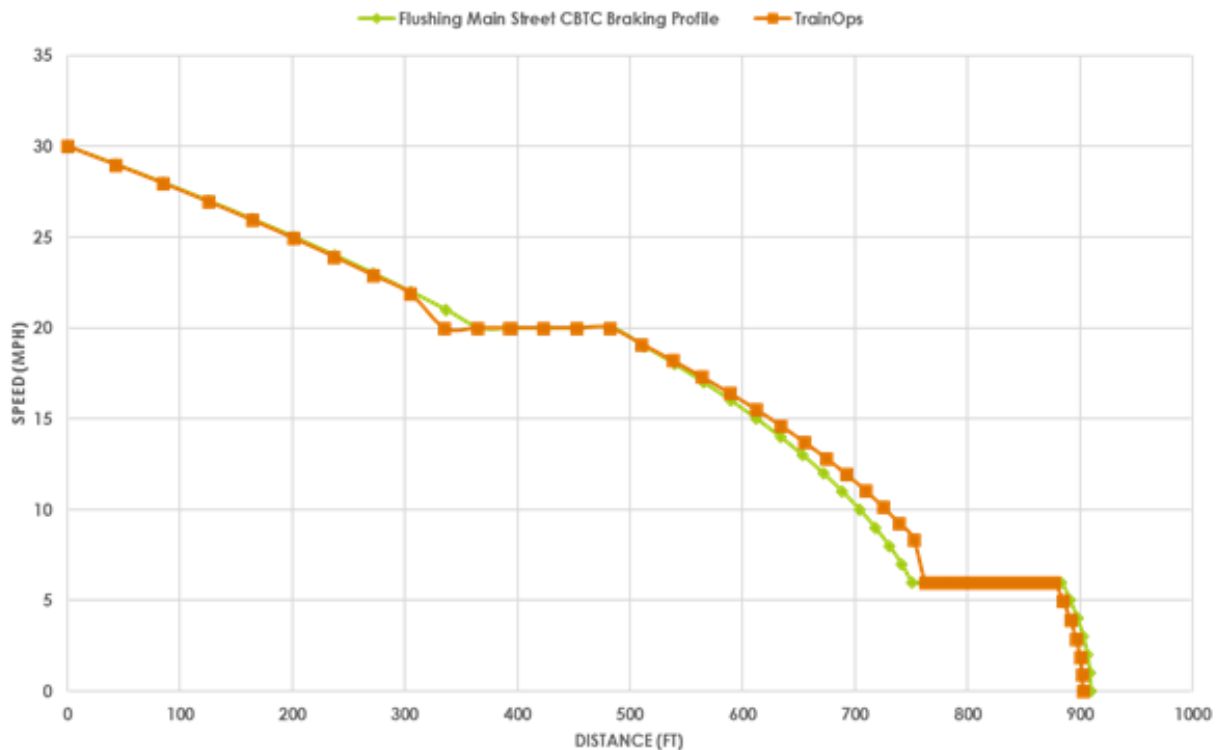


APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

One of the critical CBTC assumptions is the issuance of Movement Authority Limits (MALs) and speed targets at end-of-track locations (such as Flatbush Avenue - Brooklyn College) and at locations where station platform abut interlockings (such as Grand Central - 42 Street northbound). According to NYCT, the Flushing Line Contract S-32723 RFI #228 (October 19, 2017) addresses this “Slack Protection” issue due to the end-of-track configuration at Flushing Main Street. NYCT directed that the full platform have an enforced 20 mph limit and that the last 113 ft of the platform have a 6 MPH limit. NYCT directed that the MAL speed be computed with a 5 MPH target at the bumper, allowing trains to fully berth without a double stop.

Figure G.1-4 shows the velocity profile associated with this implementation in green and the TrainOps® simulation emulation of “Slack Protection” in orange.

Figure G.1-4: Slack Protection at Flushing Main Street



G.1.2.6 Communications-Based Train Control Braking Distance Model and System Latencies

CBTC safe braking distance models are considerably more complex than traditional wayside safe braking distance models. In the case of CBTC models, multiple safe braking distance model stages are required. There are typically four stages:

- Stage 1 – Code Recognition Time (Maintain Speed), reflecting the time for the vehicle to interpret the commands from the wayside;
- Stage 2 – Run-Away Acceleration (Acceleration), reflecting a wrong-side failure of non-vital propulsion equipment or a train that was simply in full acceleration at the

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

start of the safe braking distance model (this will be based on the CBTC or high-rate acceleration curve as shown in Figure G.1-6;

- Stage 3 – Power Removal Time (Maintain Speed), reflecting time to remove traction power and to begin to apply the brakes; and
- Stage 4 – Brake to Stop or to civil speed target.

The CBTC model parameters are defined in Table G.1-4 and shown graphically in Figure G.1-5. This applies to both the safe braking distance model (profile to a stop signal) and safe reducing distance model (profile to a civil speed restriction).

Table G.1-4. NYCT CBTC Simulation Parameters

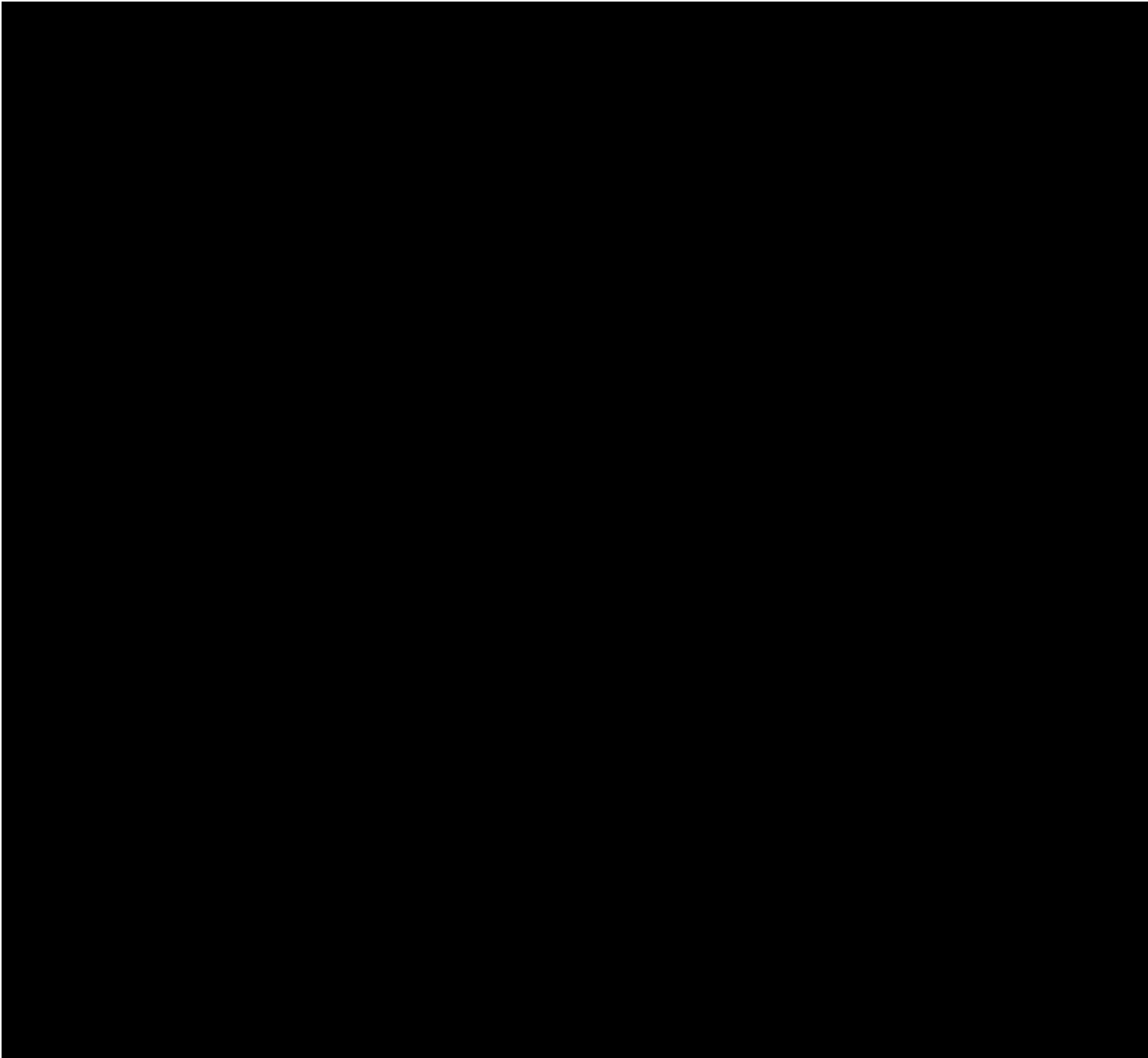
Item #	Parameter	NYCT Value	Description
CBTC Vehicle Performance for Computation of Movement Authorities			
1	Overspeed detection time (runaway acceleration)	2.0 sec	Runaway acceleration based on high rate CBTC train performance. Also covers train that is underspeed and accelerating.
2	Power removal time (runaway acceleration)	0.650 sec	Runaway acceleration based on high rate CBTC train performance.
3	Coast/brake build-up	2.0 sec	Jerk rate limit of 2mph/s/s between #2 and #4 causes total of coasting and brake build-up to be about 2 sec.
4	Guaranteed Emergency Brake Rate (GEBR)	-1.8 mph/s	NYCT is using -1.4 mph/s on Queens Boulevard Line CBTC but recent vehicle tests show support for a higher GEBR.
5	ATP overspeed allowance	1.5 mph	Allowance in the Safe Braking Distance model to prevent nuisance alarms/penalties when train is approaching maximum authorized speed.
6	Worst case speedometer error	2.0 mph	Allowance in the Safe Braking Distance model to accommodate a train that is actually moving faster than speedometer results.
CBTC System Performance			
7	Buffer distance ahead of train	0 ft	Safety buffer separate from any accounting of Positional Uncertainty (see below). NYCT indicates this is already accounted for in braking model.
8	Buffer distance behind train	0 ft	Safety buffer separate from any accounting of Positional Uncertainty (see below). NYCT indicates this is already accounted for in braking model.
9	Maximum train to wayside communication time	500 ms x 2 cycles = 1.0 sec	For headway (following move) purposes, based on Thales "FLNY Timing Analysis – CBTC" document.
10	Wayside to train communication	500 ms x 2 cycles = 1.0 sec	For headway (following move) purposes, based on Thales "FLNY Timing Analysis – CBTC" document.
11	On-board computer update interval	350 ms x 2 cycles = 0.7 sec	For headway (following move) purposes, conservative (long) values based on suggestion by NYCT CBTC Team.

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.1-4. NYCT CBTC Simulation Parameters

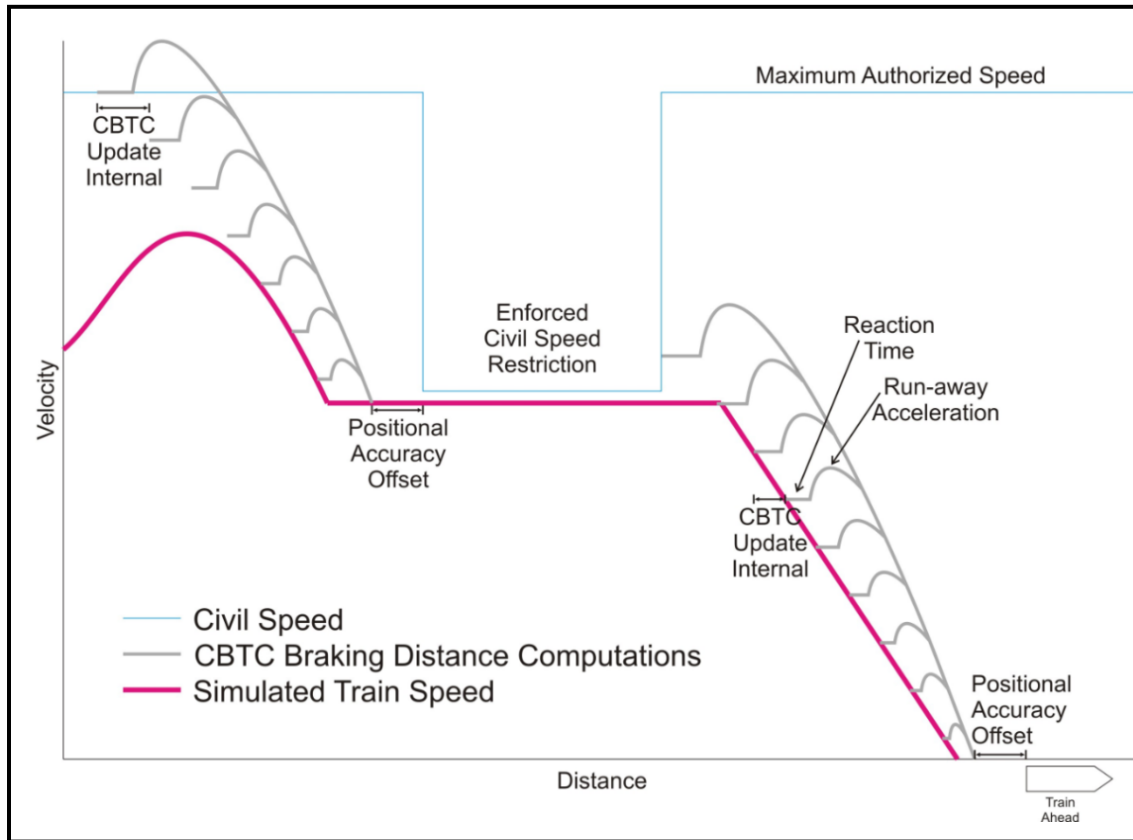
Item #	Parameter	NYCT Value	Description
12	Maximum speed measurement error (mph)	1% (modeled in TrainOps® as Schedule Margin)	Will adjust vehicle speed down by 1% in network simulation (not in computation of CBTC safe braking distance minimum separation) for conservative trip time and capacity assessment. For example, 50 mph will be adjusted to 49.5 mph.
13	Maximum positional uncertainty	30 ft.	Applied separately to both front and back of train. NYCT value is based on assumed maximum 1000 ft separation between transponders with maximum possible 3% accumulated error. Applies to both train ahead (could be closer than computed) and train behind (could be closer than computed).
14	ATO station stop brake rate	2.1 mph/s	Higher than GEBR due to lack of need for vitality. NYCT has suggested 2.3 to 2.4 mph/s. However, a sample of 10 Car 8116 stops yielded 2.11 mph/s and a sample of 10 Car 8112 stops yielded 1.83 mph/s.
15	CBTC MAL targets within interlockings	Treat interlocking route as entirely occupied or entirely unoccupied unless intermediate signals installed	Intermediate signals allow subdivision of CBTC Movement Authority within interlocking but only signal-to-signal.
16	CBTC MAL updates after interlocking sectional route release		NYCT has indicated that it does not use sectional route release within interlockings.
17	Station Movement Authorities prevent partial berthing	<ul style="list-style-type: none"> A train berthed in the station won't move until it has a MAL that will let it clear the station. "Usable Platform" Limits must be cleared. The distance from the berthing position to the end of the usable platform varies, but typically not more than 15 feet + train length + distance from the end of the departing train's MAL to the rear of a train ahead, say 70-100 feet. Once the train berthed in the station moves, absent any restriction such as a Home Signal at the exiting end that prevents a train from berthing, the following train can enter. On top of this, communication and reaction delays have to be added. 	Per NYCT MOW Engineering 10/30/2018
18	End of track approach speeds	With bumper at end of platform, platform limits enforced at 20 mph with last 113 ft enforced at 6 mph. Bumper enforced at 5 mph based on its structural design.	Slack Protection functionality, emulating Flushing Line
19	Station berthing with end-of-platform interlocking signal at stop	With interlocking home signal at end of platform at stop, platform limits enforced at 20 mph with last 113 ft enforced at 6 mph. Signal at stop enforced at 5 mph based on approximate distance from trip stop to converging route fouling point.	Slack Protection functionality, emulating Flushing Line

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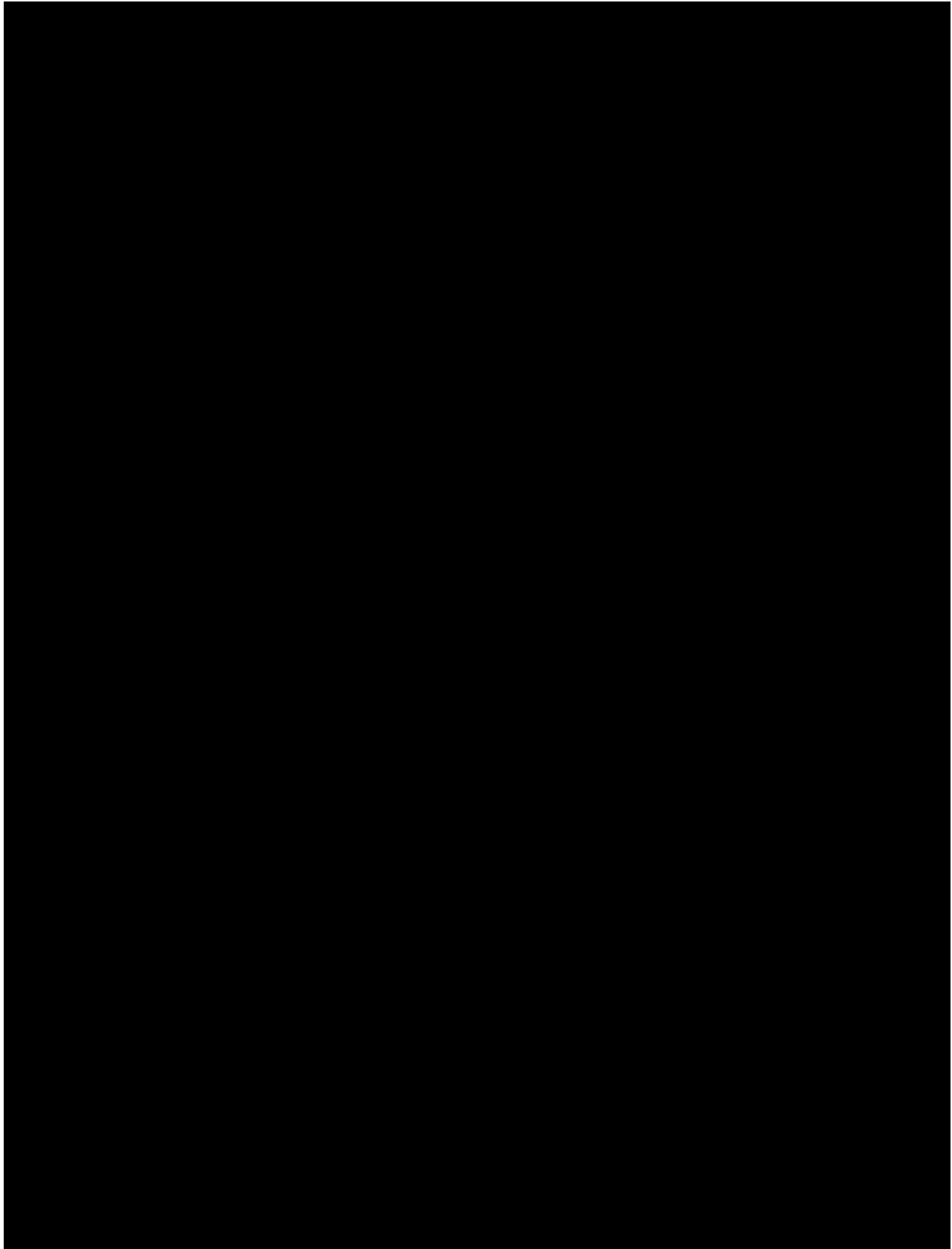
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Figure G.1-6: CBTC (Moving Block and Virtual Moving Block) Train Performance Modelling
Showing Both Civil Speed and Train Ahead (“Stop Signal”) Profiling



G.1.2.7 Interlocking Route Establishment and Release Times

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G.1.3 Operations

G.1.3.1 Schedules

NYCT directed that revised CBTC operating plans with higher service delivery targets be assumed for the future baseline simulation. The schedules are based on the operating plans developed for Phases I-II. Timepoints were kept the same as in Phases I-II as much as possible. Similar to Phase I-II schedules, off-peak service plans and patterns were based on 2019 NYCT subway schedules with added service in the peak periods to attain a 30 TPH service level on most A-Division segments. By retaining existing levels of service in the midday and overnight hours, the future baseline plan features more intensive “ramp up” and “ramp down” operations that stress terminals and yard/mainline interfaces. Refer to Section G.2 for CBTC operating plans for each line.

The future baseline plan developed by LTK recognizes Nostrand Junction as one of the critical A-Division bottlenecks. Because of the track layout, the total of 2, 3 and 5 service to Flatbush Avenue and on the local track to Utica Avenue cannot exceed 30 TPH. The resultant peak period train volumes are:

- 1 Line – 30 TPH
- 2 Line – 13 TPH
- 3 Line – 13 TPH
- 4 Line – 21 TPH
- 5 Line – 9 TPH, and
- 6 Line – 30 TPH

This results in the combined 2 and 3 Lines at 26 TPH, the combined 4 and 5 Lines at 30 TPH and the 1 and 6 Lines each at 30 TPH. The future baseline plan schedules the 30 TPH volume for at least two hours in the peak – approximately 7 a.m. to 9 a.m. and 4:30 p.m. to 6:30 p.m. The off-peak A-Division operating plans are based on the same RTIF source files as the baseline calibration simulation, as shown in Table G.1-6.

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**Table G.1-6. NYCT RTIF Existing Operating Plan Source Files
for A-Division Simulation**

Line	Description	Effective Date
1	Broadway-7 Avenue Local	May 2, 2018
2	Broadway-7 Avenue Express	May 15, 2018
3	Broadway-7 Avenue Express	May 15, 2018
4	Lexington Avenue Express	May 25, 2018
5	Lexington Avenue Express	May 15, 2018
6	Lexington Avenue Local	May 15, 2015
S	Grand Central – Times Square Shuttle	March 23, 2017

G.1.3.2 Passenger Loads

The simulated A-Division fleets have load weighing capabilities that generally adjust tractive effort and braking effort to achieve comparable performance for a range of passenger loading conditions. Only at “Standing Heavy” loads do A-Division cars experience modestly degraded acceleration and deceleration. Referring to the passenger capacities per car in Table G.1-1, the following Simulated Passenger Load definitions referenced in Table G.1-7 apply:

- Seated: All seats occupied by passengers;
- Standing Light: All seats occupied by passengers and one-third of maximum standing space occupied by passengers;
- Standing Medium: All seats occupied by passengers and two-thirds of maximum standing space occupied by passengers; and
- Standing Heavy: All seats occupied by passengers and all the standing space occupied by passengers.

Table G.1-7 summarizes the assumed passenger load in simulation by A-Division Line, direction, and trip start time. Consistent with the NYCT RTIF file input, some of the 5 Line trips are considered as 5X trips (express in the Bronx). Similarly, some of the 6 Line trips are considered as 6X trips (express in the Bronx).

**Table G.1-7. A-Division Assumed Passenger Loadings
by Line, Direction and Time**

Line	Direction	Start Time	End Time	Simulated Passenger Load
1	N	0:00	6:00	Seated
1	S	0:00	6:00	Seated
1	N	6:00	9:00	Standing Light
1	S	6:00	9:00	Standing Medium
1	N	9:00	16:00	Standing Light
1	S	9:00	16:00	Standing Light
1	N	16:00	19:00	Standing Medium
1	S	16:00	19:00	Standing Light

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**Table G.1-7. A-Division Assumed Passenger Loadings
by Line, Direction and Time**

Line	Direction	Start Time	End Time	Simulated Passenger Load
1	N	19:00	0:00	Seated
1	S	19:00	0:00	Seated
2	N	0:00	6:00	Seated
2	S	0:00	6:00	Seated
2	N	6:00	9:00	Standing Medium
2	S	6:00	9:00	Standing Medium
2	N	9:00	16:00	Standing Light
2	S	9:00	16:00	Standing Light
2	N	16:00	19:00	Standing Medium
2	S	16:00	19:00	Standing Medium
2	N	19:00	0:00	Seated
2	S	19:00	0:00	Seated
3	N	0:00	6:00	Seated
3	S	0:00	6:00	Seated
3	N	6:00	9:00	Standing Medium
3	S	6:00	9:00	Standing Medium
3	N	9:00	16:00	Standing Light
3	S	9:00	16:00	Standing Light
3	N	16:00	19:00	Standing Medium
3	S	16:00	19:00	Standing Medium
3	N	19:00	0:00	Seated
3	S	19:00	0:00	Seated
4	N	0:00	6:00	Seated
4	S	0:00	6:00	Seated
4	N	6:00	9:00	Standing Heavy
4	S	6:00	9:00	Standing Heavy
4	N	9:00	16:00	Standing Light
4	S	9:00	16:00	Standing Light
4	N	16:00	19:00	Standing Heavy
4	S	16:00	19:00	Standing Heavy
4	N	19:00	0:00	Seated
4	S	19:00	0:00	Seated
5	N	0:00	6:00	Seated
5	S	0:00	6:00	Seated
5	N	6:00	9:00	Standing Heavy
5	S	6:00	9:00	Standing Heavy
5	N	9:00	16:00	Standing Light
5	S	9:00	16:00	Standing Light
5	N	16:00	19:00	Standing Heavy
5	S	16:00	19:00	Standing Heavy
5	N	19:00	0:00	Seated
5	S	19:00	0:00	Seated
5X	N	0:00	6:00	Seated
5X	S	0:00	6:00	Seated

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**Table G.1-7. A-Division Assumed Passenger Loadings
by Line, Direction and Time**

Line	Direction	Start Time	End Time	Simulated Passenger Load
5X	N	6:00	9:00	Standing Heavy
5X	S	6:00	9:00	Standing Heavy
5X	N	9:00	16:00	Standing Light
5X	S	9:00	16:00	Standing Light
5X	N	16:00	19:00	Standing Heavy
5X	S	16:00	19:00	Standing Heavy
5X	N	19:00	0:00	Seated
5X	S	19:00	0:00	Seated
6	N	0:00	6:00	Seated
6	S	0:00	6:00	Seated
6	N	6:00	9:00	Standing Medium
6	S	6:00	9:00	Standing Medium
6	N	9:00	16:00	Standing Light
6	S	9:00	16:00	Standing Light
6	N	16:00	19:00	Standing Medium
6	S	16:00	19:00	Standing Medium
6	N	19:00	0:00	Seated
6	S	19:00	0:00	Seated
6X	N	0:00	6:00	Seated
6X	S	0:00	6:00	Seated
6X	N	6:00	9:00	Standing Medium
6X	S	6:00	9:00	Standing Medium
6X	N	9:00	16:00	Standing Light
6X	S	9:00	16:00	Standing Light
6X	N	16:00	19:00	Standing Medium
6X	S	16:00	19:00	Standing Medium
6X	N	19:00	0:00	Seated
6X	S	19:00	0:00	Seated
S	N	0:00	6:00	Seated
S	S	0:00	6:00	Seated
S	N	6:00	9:00	Standing Medium
S	S	6:00	9:00	Standing Medium
S	N	9:00	16:00	Standing Medium
S	S	9:00	16:00	Standing Medium
S	N	16:00	19:00	Standing Medium
S	S	16:00	19:00	Standing Medium
S	N	19:00	0:00	Seated
S	S	19:00	0:00	Seated

G.1.3.3 Train Consists

All simulated train consists, except for the Grand Central – Times Square shuttle, are 10-car R188 consists operating in CBTC (“high rate”) mode.

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G.1.3.4 Dwell Times

NYCT Operations Planning developed an extensive database of dwell times, specific to stations, lines, directions and times of day. This was based on ATS data and the use of conversion actors to convert track circuit occupancy (“trigger points”) into actual wheel stop/wheel start dwell times. These dwells range from 20 seconds to 60 seconds, of which about 12 seconds is Conductor reaction time to open the doors, door cycle time and Train Operator reaction time to begin moving the train. Dwell times vary by time of day (morning peak period, evening peak period or off-peak), by direction, by track and by line. These dwell times have been applied to both the wayside and CBTC simulation models.

The dwell times in the CBTC simulation are somewhat more optimistic than the dwell times NYCT currently reports under wayside operations.

The longest simulated dwells are at the following stations:

- President Street (60 seconds northbound in the evening);
- Grand Central - 42 Street (55 seconds northbound on Track 3 in the evening, 50 seconds southbound on Track 2 in the morning);
- 14 Street - Union Square (50 seconds southbound on Track 1 in the evening, 50 seconds southbound on Track 2 in both the morning and evening); and
- East 180 Street (65 seconds northbound on Track M in the evening).

A minimum dwell of 20 seconds was assigned even if ATS data showed a lower average dwell. The resultant dwells for simulation are shown in Table G.1-8 (the ② and ③ Lines) and Table G.1-9 (the ④, ⑤ and ⑥ Lines).

NYCT provided overnight service dwell times that are not reflected in Table G.1-9 such as for the ④ Line that provides local service between Crown Heights - Utica Avenue and New Lots Avenue when the ③ Line is not operating.

Table G.1-8. Dwell Time Inputs ①, ② and ③ Lines

Station	Track	Dir	① Line			② Line			③ Line		
			AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak
Nevins Street	1	S				30	35	30	30	35	30
Nevins Street	4	N				30	25	25	30	25	25
Atlantic Avenue	1	S				25	35	25	25	35	25
Atlantic Avenue	4	N				35	25	25	35	25	25
Bergen Street	1	S				20	20	20	20	20	20
Bergen Street	4	N				20	20	20	20	20	20
Grand Army Plaza	1	S				25	25	25	25	25	25
Grand Army Plaza	4	N				25	20	20	25	20	20
Eastern Pkwy-Bklyn Museum	1	S				25	25	25	25	25	25
Eastern Pkwy-Bklyn Museum	4	N				20	20	20	20	20	20
Franklin Avenue	1	S				35	40	30	35	40	30
Franklin Avenue	4	N				35	35	35	35	35	35
President Street	2	S				30	30	30			

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Table G.1-8. Dwell Time Inputs ①, ② and ③ Lines

Station	Track	Dir	① Line			② Line			③ Line		
			AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak
President Street	3	N				50	60	40			
Sterling Street	2	S				20	20	20			
Sterling Street	3	N				20	20	20			
Winthrop Street	2	S				20	20	20			
Winthrop Street	3	N				20	20	20			
Church Avenue	2	S				30	30	30			
Church Avenue	3	N				30	25	25			
Beverly Rd	2	S				25	20	25			
Beverly Rd	3	N				20	20	20			
Newkirk Avenue	2	S				30	30	30			
Newkirk Avenue	3	N				20	20	20			
Nostrand Avenue	1	S				25	30	25	25	30	25
Nostrand Avenue	4	N				30	40	25	30	40	25
Kingston Avenue	1	S				20	25	20	20	25	20
Kingston Avenue	4	N				20	20	20	20	20	20
Crown Heights - Utica Avenue	1	S				30	40	35	30	40	35
Crown Heights - Utica Avenue	4	N				40	45	30	40	45	30
Sutter Avenue - Rutland Rd	1	S				20	25	20	20	25	20
Sutter Avenue - Rutland Rd	4	N				25	20	20	25	20	20
Saratoga Avenue	1	S				25	30	30	25	30	30
Saratoga Avenue	4	N				35	30	30	35	30	30
Rockaway Avenue	1	S				20	25	20	20	25	20
Rockaway Avenue	4	N				25	20	20	25	20	20
Junius Street	1	S				20	25	20	20	25	20
Junius Street	4	N				20	20	20	20	20	20
Pennsylvania Avenue	1	S				20	25	20	20	25	20
Pennsylvania Avenue	4	N				20	20	20	20	20	20
Van Siclen Avenue	1	S				25	30	25	25	30	25
Van Siclen Avenue	4	N				20	20	20	20	20	20
Hoyt Street	1	S				20	20	20	20	20	20
Hoyt Street	4	N				25	20	20	25	20	20
Borough Hall	2	S				20	25	20	20	25	20
Borough Hall	3	N				25	25	25	25	25	25
Clark Street	2	S				20	25	20	20	25	20
Clark Street	3	N				25	25	20	25	25	20
Wall Street	2	S				30	30	25	30	30	25
Wall Street	3	N				30	35	30	30	35	30
Fulton Street	2	S				35	35	30	35	35	30
Fulton Street	3	N				30	35	30	30	35	30
Park Pl	2	S				30	30	25	30	30	25
Park Pl	3	N				30	40	30	30	40	30
Rector Street	1	S	25	20	25						
Rector Street	4	N	20	20	20						
Cortlandt Street	1	S	20	20	20						
Cortlandt Street	4	N	20	20	20						
Chambers Street	1	S	30	25	25						
Chambers Street	2	S				35	30	30	35	30	30
Chambers Street	3	N				30	35	30	30	35	30
Chambers Street	4	N	25	25	25						

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Table G.1-8. Dwell Time Inputs 1, 2 and 3 Lines

Station	Track	Dir	1 Line			2 Line			3 Line		
			AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak
Franklin Street	1	S	20	20	20			20			
Franklin Street	4	N	20	20	20			20			
Canal Street	1	S	20	20	20			20			
Canal Street	4	N	20	20	20			20			
Houston Street	1	S	20	20	20			20			
Houston Street	4	N	20	25	20			20			
Christopher Street-Sheridan Sq	1	S	20	20	20			20			
Christopher Street-Sheridan Sq	4	N	20	20	20			20			
14 Street	1	S	30	25	25			25			
14 Street	2	S				30	25	25	30	25	25
14 Street	3	N				25	35	25	25	35	25
14 Street	4	N	30	30	25			25			
18 Street	1	S	20	20	20			20			
18 Street	4	N	20	25	20			20			
23 Street	1	S	20	20	20			20			
23 Street	4	N	20	25	20			20			
28 Street	1	S	20	20	20			20			
28 Street	4	N	20	25	20			20			
34 Street-Penn Station	1	S	30	30	30			30			
34 Street-Penn Station	2	S				35	35	30	35	35	30
34 Street-Penn Station	3	N				40	45	30	40	45	30
34 Street-Penn Station	4	N	35	35	25			25			
Times Sq-42 Street	1	S	50	50	40			40			
Times Sq-42 Street	2	S				50	50	35	50	50	35
Times Sq-42 Street	3	N				45	50	35	45	50	35
Times Sq-42 Street	4	N	45	50	35			35			
50 Street	1	S	25	25	20			20			
50 Street	4	N	25	30	25			25			
59 Street-Columbus Circle	1	S	35	30	30			30			
59 Street-Columbus Circle	4	N	30	35	30			30			
66 Street	1	S	25	25	20			20			
66 Street	4	N	20	25	20			20			
72 Street	1	S	35	30	30			30			
72 Street	2	S				35	30	25	35	30	25
72 Street	3	N				25	35	25	25	35	25
72 Street	4	N	30	35	30			30			
79 Street	1	S	25	20	20			20			
79 Street	4	N	20	20	20			20			
86 Street	1	S	20	20	20			20			
86 Street	4	N	20	25	20			20			
96 Street	1	S	40	35	35			35			
96 Street	2	S				40	30	30	40	30	30
96 Street	3	N				30	35	30	30	35	30
96 Street	4	N	30	45	30			30			
103 Street	1	S	25	20	20						
103 Street	4	N	20	25	20						
Cathedral Pkwy-110 Street	1	S	25	20	20						
Cathedral Pkwy-110 Street	4	N	20	25	20						
116 Street-Columbia University	1	S	20	20	20						

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Table G.1-8. Dwell Time Inputs ①, ② and ③ Lines

Station	Track	Dir	① Line			② Line			③ Line		
			AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak
116 Street-Columbia University	4	N	20	20	20						
125 Street	1	S	20	20	20						
125 Street	4	N	20	20	20						
137 Street-City College	1	S	30	20	30						
137 Street-City College	4	N	25	30	25						
145 Street	1	S	20	20	20						
145 Street	4	N	20	20	20						
157 Street	1	S	25	20	20						
157 Street	4	N	20	20	20						
168 Street	1	S	20	20	20						
168 Street	4	N	20	20	20						
181 Street	1	S	25	20	20						
181 Street	4	N	20	25	20						
191 Street	1	S	20	20	20						
191 Street	4	N	20	20	20						
Dyckman Street	1	S	20	20	20						
Dyckman Street	4	N	20	20	20						
207 Street	1	S	20	20	20						
207 Street	4	N	20	20	20						
215 Street	1	S	20	20	20						
215 Street	4	N	20	20	20						
Marble Hill-225 Street	1	S	20	20	20						
Marble Hill-225 Street	4	N	20	20	20						
231 Street	1	S	25	20	20						
231 Street	4	N	20	25	20						
238 Street	1	S	20	20	20						
238 Street	4	N	20	25	25						
Central Park North-110 Street	2	S				25	25	25	25	25	25
Central Park North-110 Street	3	N				30	35	30	30	35	30
116 Street ② ③	2	S				25	25	25	25	25	25
116 Street ② ③	3	N				20	25	20	20	25	20
125 Street ② ③	2	S				25	25	20	25	25	20
125 Street ② ③	3	N				25	30	25	25	30	25
135 Street	2	S				25	25	25	25	25	25
135 Street	3	N				30	40	30	30	40	30
145 Street ③	1	S							25	25	25
145 Street ③	4	N							30	45	30
149 Street-Grand Concourse	2	S				50	40	45			
149 Street-Grand Concourse	3	N				25	35	25			
3 Avenue-149 Street	2	S				40	25	25			
3 Avenue-149 Street	3	N				25	35	25			
Jackson Avenue	2	S				40	25	25			
Jackson Avenue	3	N				25	25	25			
Prospect Avenue	2	S				25	20	25			
Prospect Avenue	3	N				20	25	20			
Intervale Avenue	2	S				20	20	20			
Intervale Avenue	3	N				20	20	20			
Simpson Street	2	S				30	30	30			
Simpson Street	3	N				25	30	30			

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Table G.1-8. Dwell Time Inputs ①, ② and ③ Lines

Station	Track	Dir	① Line			② Line			③ Line		
			AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak
Freeman Street	2	S				20	20	20			
Freeman Street	3	N				20	20	20			
174 Street	2	S				25	25	25			
174 Street	3	N				25	25	25			
West Farms Sq-E Tremont Avenue	2	S				30	30	30			
West Farms Sq-E Tremont Avenue	3	N				30	30	30			
E 180 Street	2	S				40	35	35			
E 180 Street	3	N				45	65	55			
Bronx Park East	2	S				30	25	25			
Bronx Park East	3	N				20	20	20			
Pelham Pkwy ② ⑤	2	S				20	20	20			
Pelham Pkwy ② ⑤	3	N				20	25	20			
Allerton Avenue	2	S				25	25	25			
Allerton Avenue	3	N				20	20	20			
Burke Avenue	2	S				20	20	20			
Burke Avenue	3	N				20	20	20			
Gun Hill Rd ② ⑤	2	S				25	25	25			
Gun Hill Rd ② ⑤	3	N				25	30	30			
219 Street	2	S				20	20	20			
219 Street	3	N				20	20	20			
225 Street ② ⑤	2	S				20	20	20			
225 Street ② ⑤	3	N				20	25	25			
233 Street	2	S				20	20	20			
233 Street	3	N				20	20	20			
Nereid Avenue	2	S				25	25	25			
Nereid Avenue	3	N				25	30	35			

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Table G.1-9. Dwell Time Inputs 4, 5 and 6 Lines

Station	Track	Dir	4 Line			5 Line			6 Line		
			AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak
Nevins Street	2	S	25	30	30	25	30	30			
Nevins Street	3	N	30	25	25	30	25	25			
Atlantic Avenue	1	S			25						
Atlantic Avenue	2	S	25	35	25	25	35	25			
Atlantic Avenue	3	N	45	35	35	45	35	35			
Atlantic Avenue	4	N			25						
Bergen Street	1	S			20						
Bergen Street	4	N			20						
Grand Army Plaza	1	S			25						
Grand Army Plaza	4	N			20						
Eastern Pkwy-Bklyn Museum	1	S			25						
Eastern Pkwy-Bklyn Museum	4	N			20						
Franklin Avenue	1	S			30						
Franklin Avenue	2	S	25	35	25	25	35	25			
Franklin Avenue	3	N	35	30	30	35	30	30			
Franklin Avenue	4	N			35						
President Street	2	S				30	30	30			
President Street	3	N				50	60	40			
Church Avenue	2	S				30	30	30			
Church Avenue	3	N				30	25	25			
Beverly Rd	2	S				25	20	25			
Beverly Rd	3	N				20	20	20			
Newkirk Avenue	2	S				30	30	30			
Newkirk Avenue	3	N				20	20	20			
Nostrand Avenue	1	S			25						
Nostrand Avenue	4	N			25						
Kingston Avenue	1	S			20						
Kingston Avenue	4	N			20						
Crown Heights - Utica Avenue	1	S			35						
Crown Heights - Utica Avenue	4	N			30						
Sutter Avenue - Rutland Rd	1	S			20	20	25	20			
Sutter Avenue - Rutland Rd	4	N			20	25	20	20			
Saratoga Avenue	1	S			30	25	30	30			
Saratoga Avenue	4	N			30	35	30	30			
Rockaway Avenue	1	S			20	20	25	20			
Rockaway Avenue	4	N			20	25	20	20			
Junius Street	1	S			20	20	25	20			
Junius Street	4	N			20	20	20	20			
Pennsylvania Avenue	1	S			20	20	25	20			
Pennsylvania Avenue	4	N			20	20	20	20			
Van Siclen Avenue	1	S			25	25	30	25			
Van Siclen Avenue	4	N			20	20	20	20			
138 Street - Grand Concourse	1	S	40	25	25	40	25	25			
138 Street - Grand Concourse	4	N	45	40	45	45	40	45			
Fulton Street	2	S	35	35	30	35	35	30			
Fulton Street	3	N	35	35	25	35	35	25			
Wall Street	2	S	30	35	30	30	35	30			

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Table G.1-9. Dwell Time Inputs 4, 5 and 6 Lines

Station	Track	Dir	4 Line			5 Line			6 Line		
			AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak
Wall Street	3	N	30	30	25	30	30	25			
Bowling Green	2	S	30	35	30	30	35	30			
Bowling Green	3	N	35	35	25	35	35	25			
Borough Hall	2	S	30	35	30	30	35	30			
Borough Hall	3	N	35	30	30	35	30	30			
3 Avenue – 138 Street	2	S							35	20	20
3 Avenue – 138 Street	M	S							30		20
3 Avenue – 138 Street	M	N								30	30
3 Avenue – 138 Street	3	N							25	35	30
125 Street	1	S	45	30	30	45	30	30			
125 Street	2	S							40	30	30
125 Street	3	N	35	45	35	35	45	35			
125 Street	4	N			35				30	50	35
116 Street	1	S			25				30	25	25
116 Street	4	N			25				25	30	25
110 Street	1	S			20				25	20	20
110 Street	4	N			20				20	25	20
103 Street	1	S			20				25	20	20
103 Street	4	N			20				20	25	20
96 Street	1	S			25				30	25	25
96 Street	4	N			20				20	25	20
86 Street	1	S			25				30	30	25
86 Street	2	S	35	30	30	35	30	30			
86 Street	3	N	30	35	30	30	35	30			
86 Street	4	N			20				20	30	20
77 Street	1	S			30				30	35	30
77 Street	4	N			20				25	30	20
68 Street - Hunter College	1	S			20				25	30	20
68 Street - Hunter College	4	N			20				25	30	20
59 Street	1	S			25				35	35	25
59 Street	2	S	40	35	30	40	35	30			
59 Street	3	N	30	35	30	30	35	30			
59 Street	4	N			25				30	35	25
51 Street	1	S			30				35	40	30
51 Street	4	N			25				35	40	25
Grand Central - 42 Street	1	S			40				45	45	40
Grand Central - 42 Street	2	S	50	45	40	50	45	40			
Grand Central - 42 Street	3	N	45	55	40	45	55	40			
Grand Central - 42 Street	4	N			35				40	45	35
33 Street	1	S			25				25	25	25
33 Street	4	N			25				25	35	25
28 Street	1	S			25				30	30	25
28 Street	4	N			25				25	30	25
23 Street	1	S			20				25	25	20
23 Street	4	N			20				20	25	20
14 Street - Union Sq	1	S			40				40	50	40
14 Street - Union Sq	2	S	50	50	45	50	50	45			

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Table G.1-9. Dwell Time Inputs 4, 5 and 6 Lines

Station	Track	Dir	4 Line			5 Line			6 Line		
			AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak
14 Street - Union Sq	3	N	45	45	35	45	45	35			
14 Street - Union Sq	4	N			35				40	40	35
Astor Pl	1	S			20				20	25	20
Astor Pl	4	N			25				25	30	25
Bleecker Street	1	S			20				20	25	20
Bleecker Street	4	N			25				30	25	25
Spring Street	1	S			20				20	20	20
Spring Street	4	N			20				20	25	20
Canal Street	1	S			20				20	20	20
Canal Street	4	N			30				25	30	30
Brooklyn Bridge	2	S	30	30	25	30	30	25			
Brooklyn Bridge	3	N	25	30	25	25	30	25			
149 Street-Grand Concourse (4)	1	S	50	40	40						
149 Street-Grand Concourse (4)	4	N	35	50	40						
161 Street-Yankee Stadium	1	S	45	55	40						
161 Street-Yankee Stadium	4	N	30	45	30						
167 Street	1	S	30	25	25						
167 Street	4	N	20	25	25						
170 Street	1	S	25	20	20						
170 Street	4	N	20	25	25						
Mt Eden Avenue	1	S	20	20	20						
Mt Eden Avenue	4	N	20	25	20						
176 Street	1	S	20	20	20						
176 Street	4	N	20	20	20						
Burnside Avenue	1	S	25	25	25						
Burnside Avenue	4	N	25	25	25						
183 Street	1	S	20	20	20						
183 Street	4	N	20	25	25						
Fordham Rd	1	S	20	20	20						
Fordham Rd	4	N	20	25	25						
Kingsbridge Rd	1	S	25	20	25						
Kingsbridge Rd	4	N	25	25	25						
Bedford Pk Blvd	1	S	20	20	25						
Bedford Pk Blvd	4	N	25	25	25						
Mosholu Pkwy	1	S	20	20	25						
Mosholu Pkwy	4	N	25	25	25						
149 Street-Grand Concourse 2 5	2	S				50	40	45			
149 Street-Grand Concourse 2 5	3	N				25	35	25			
3 Avenue-149 Street	2	S				40	25	25			
3 Avenue-149 Street	3	N				25	35	25			
Jackson Avenue	2	S				40	25	25			
Jackson Avenue	3	N				25	25	25			
Prospect Avenue	2	S				25	20	25			

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Table G.1-9. Dwell Time Inputs 4, 5 and 6 Lines

Station	Track	Dir	4 Line			5 Line			6 Line		
			AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak
Prospect Avenue	3	N				20	25	20			
Intervale Avenue	2	S				20	20	20			
Intervale Avenue	3	N				20	20	20			
Simpson Street	2	S				30	30	30			
Simpson Street	3	N				25	30	30			
Freeman Street	2	S				20	20	20			
Freeman Street	3	N				20	20	20			
174 Street	2	S				25	25	25			
174 Street	3	N				25	25	25			
West Farms Sq-E Tremont Avenue	2	S				30	30	30			
West Farms Sq-E Tremont Avenue	3	N				30	30	30			
E 180 Street	2	S				40	35	35			
E 180 Street	M	S				40		75			
E 180 Street	M	N						95			
E 180 Street	3	N				45	65	55			
Bronx Park East	2	S				30	25	25			
Bronx Park East	3	N				20	20	20			
Pelham Pkwy 2 5	2	S				20	20	20			
Pelham Pkwy 2 5	3	N				20	25	20			
Allerton Avenue	2	S				25	25	25			
Allerton Avenue	3	N				20	20	20			
Burke Avenue	2	S				20	20	20			
Burke Avenue	3	N				20	20	20			
Gun Hill Rd 2 5	2	S				25	25	25			
Gun Hill Rd 2 5	3	N				25	30	30			
219 Street	2	S				20	20	20			
219 Street	3	N				20	20	20			
225 Street 2 5	2	S				20	20	20			
225 Street 2 5	3	N				20	25	25			
233 Street	2	S				20	20	20			
233 Street	3	N				20	20	20			
Nereid Avenue	2	S				25	25	25			
Nereid Avenue	3	N				25	30	35			
Morris Park	1	S				20	20	20			
Morris Park	2	N				20	20	25			
Pelham Pkwy 5	1	S				20	20	20			
Pelham Pkwy 5	2	N				20	20	20			
Gun Hill Rd 5	1	S				25	20	20			
Gun Hill Rd 5	2	N				20	20	20			
Baychester Avenue	1	S				25	20	20			
Baychester Avenue	2	N				20	20	20			
Brook Avenue	2	S							25	20	20
Brook Avenue	3	N							20	20	20

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Table G.1-9. Dwell Time Inputs 4, 5 and 6 Lines

Station	Track	Dir	4 Line			5 Line			6 Line		
			AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak	AM Peak	PM Peak	Off-peak
Cypress Avenue	2	S							20	20	20
Cypress Avenue	3	N							20	20	20
E 143 Street-Street Mary's Street	2	S							20	20	20
E 143 Street-Street Mary's Street	3	N							20	20	20
E 149 Street	2	S							20	20	20
E 149 Street	3	N							20	20	20
Longwood Avenue	2	S							20	20	20
Longwood Avenue	3	N							20	20	20
Hunts Point Avenue	2	S							40	25	30
Hunts Point Avenue	M	S							40		30
Hunts Point Avenue	M	N								35	35
Hunts Point Avenue	3	N							30	40	35
Whitlock Avenue	2	S							20	20	20
Whitlock Avenue	3	N							20	20	20
Elder Avenue	2	S							20	20	20
Elder Avenue	3	N							20	20	20
Morrison Avenue-Soundview	2	S							20	20	20
Morrison Avenue-Soundview	3	N							20	20	20
Street Lawrence Avenue	2	S							20	20	20
Street Lawrence Avenue	3	N							20	25	20
Parkchester	2	S							20	20	20
Parkchester	M	S							35		30
Parkchester	M	N								55	55
Parkchester	3	N							25		30
Castle Hill Avenue	2	S							20	20	20
Castle Hill Avenue	3	N							20	20	20
Zerega Avenue	2	S							20	20	20
Zerega Avenue	3	N							20	20	20
Westchester Sq-E Tremont Avenue	2	S							20	20	20
Westchester Sq-E Tremont Avenue	3	N							20	20	20
Middletown Rd	2	S							25	25	25
Middletown Rd	3	N							25	30	25
Zerega Avenue	2	S							20	20	20
Zerega Avenue	3	N							20	20	20

G.1.3.5 Terminal Turn Times

The simulation model has the following locations where trains “turn” (change direction) at terminals:

- New Lots Avenue;

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- Crown Heights - Utica Avenue (using relay tail tracks);
- Flatbush Avenue - Brooklyn College;
- 3 Avenue -138 Street Center Track (limited 6 Line trips in the peak period);
- South Ferry;
- Times Square - 42 Street (limited 3 Line trips during late nights using relay tracks);
- Harlem -148 Street;
- Van Cortlandt Park - 242 Street;
- Woodlawn;
- Wakefield - 241 Street;
- Eastchester - Dyre Avenue;
- Parkchester (using relay tracks); and
- Pelham Bay Park.

NYCT directed that 90 seconds serve as the minimum turn time at these locations when train crews are striving to recover from accrued lateness. At Crown Heights - Utica Avenue, this applies solely to the time on the tail track. NYCT tries to schedule a 9- to 10-minute minimum turn time at Crown Heights - Utica Avenue, including time from letting passengers off, relaying, and wheel start for departure in relay position. These turns involve a switch crew at both ends of the train to make the turn in 90 seconds.

In addition, the tail (fifth) track at Atlantic Avenue is used for “turning” non-revenue trains operating between New Lots Avenue Yard and Flatbush Avenue - Brooklyn College. This is accomplished with a single crew; NYCT directed that a minimum turn time of 10 minutes be assumed at this location, given that the Train Operator must walk the length of the train.

The tail (fifth) track south of Times Square - 42 Street is also used overnight for turning 3 Line trains operating between Times Square - 42 Street and Harlem - 148 Street. This is accomplished with a single crew; NYCT directed that a minimum turn time of 8 minutes be assumed at this location, given that the Train Operator must walk the length of the train.

NYCT directed that a minimum turn time of 8 minutes be assumed at the following locations for yard put-ins and lay-ups:

- 137 Street Yard;
- 239 Street Yard (for reverse direction operation to/from Wakefield - 241 Street); and

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- 240 Street Yard (for reverse direction operation to/from Van Cortlandt Park - 242 Street).

At the two loop terminals (Bowling Green and Brooklyn Bridge - City Hall), no explicit turn time is required as the train continues in the same direction. At Battery Park Loop (Bowling Green), 5 Line trains often wait on the loop until their prescribed slot becomes available, between successive 4 Line trains from Crown Heights - Utica Avenue. At the Brooklyn Bridge - City Hall Loop, 6 Line trains often wait for scheduled departure times of 6 Line trains ahead, departing northbound from the station.

Although no sweeping of trains occurs at Brooklyn Bridge - City Hall, the STV Team initially applied a 60-second dwell for southbound 6 Line trains leaving revenue service and about to enter the Brooklyn Bridge - City Hall Loop (as a terminal, NYCT did not provide dwell time guidance in Table G.2-6 for this service at this location). This same dwell was applied to northbound 6 Line trains as well. Due to slack protection associated with Brooklyn Bridge - City Hall Loop Interlocking that provides access to two tail tracks and the short Future Baseline (CBTC) headways between the 6 Line trains during the peak, initial Future Baseline simulations showed cascading delays at this location. With the concurrence of NYCT, dwell times for 6 Line trips in both directions were changed from 60 seconds to 45 seconds at Brooklyn Bridge - City Hall. With the dwell time reduction and the retention of Brooklyn Bridge - City Hall Loop Interlocking and its CBTC slack protection, reliable 30 TPH operation was achieved.

G.1.3.6 Routing

Routing, in terms of specific track assignments at each served station, is defined by the data in the RTIF files. The only exception to this is dynamic assignment of tracks at New Lots Avenue terminal, where the two station tracks are used in alternating order by turning trains. A similar dynamic routing situation exists at the Crown Heights - Utica Avenue tail tracks and at Flatbush Avenue - Brooklyn College when the 5 Line service is not operating. During peak and midday time periods when both the 2 and 5 Lines serve Flatbush Avenue - Brooklyn College, Track 3 (the normally northbound track) is used exclusively by the 2 Line while Track 2 (the normally southbound track) is used exclusively by the 5 Line.

A-Division operations in the Bronx feature several peak period-oriented operations and routings given the three-track nature of all five lines. For example, the complex “slot swapping” and merging operation of the 5 Line trains between 3 Avenue - 138 Street and the Lexington Avenue Line Harlem River Tubes is managed by having the southbound morning peak period 4 Line trains operate on the center track between 149 Street - Grand Concourse and 138 Street - Grand Concourse with the merge occurring south of 138 Street - Grand Concourse. In the northbound morning peak period, all 4 Line and 5 Line trains use the local track through 138 Street - Grand Concourse. The evening patterns are reversed with the center track between the diverge just south of 138 Street - Grand Concourse and 149 Street - Grand Concourse used by all 4 Line trains, bypassing the 138 Street - Grand Concourse station.

Except for the 4 Line operation at 138 Street - Grand Concourse, the Jerome Avenue Line center track is not normally used for scheduled revenue movements. Similarly, the

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center tracks of the Broadway and Dyre Avenue Lines in the Bronx are not normally used for revenue service.

G.1.3.7 Schedule Margin and Braking Comfort Factors

Simulation schedule margin is an overall derating of acceleration, maximum operating speed and deceleration, as well as adjustment of dwell. Schedule margin is typically in the 5 to 15 percent range. Given the presence of ATO throughout the future CBTC-equipped network, schedule margin was reduced from the 5 percent wayside value to 1 percent under CBTC with ATO.

TrainOps® braking comfort factors are a way of derating train performance beyond schedule margin. In order to enforce a comfortable braking rate for passengers and to achieve a “best fit” with the event recorder data, all trips are limited to 60% of the available braking effort for station stops, for civil speed restrictions and for approaching signals at stop.

In simulation, brake rates vary between stops due to differing grade, curve, weight, and air resistance. Overall, the simulated braking rates under CBTC were in the 1.4 to 1.6 MPHPS range, typical for rapid transit operations but significantly below the 3.0 MPHPS deceleration capability of the A-Division fleet.

G.1.3.8 Operating Variability

Operating variability was applied to train put-ins at the boundaries of the combined Phase I and Phase II simulation model. This variability reflected existing manual train operation and significant differences in trip-by-trip performance. Variability was applied to the following locations:

- Nevins Street southbound – 2 and 3 Lines,
- 149 Street - Grand Concourse (UL) southbound – 4 Line
- 149 Street - Grand Concourse (LL) southbound – 5 Line,
- 3 Avenue - 138 Street southbound – 6 Line.

As the Phases I-IV model simulates the full network, applying operating variability to train put-ins at the above locations is no longer necessary and has been removed.

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G.2 Future Baseline (CBTC) Operating Plan (A-Division Phases I-IV)

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G.2.1 1 Line Operating Plan

Table G.2-1. Future Baseline (CBTC) Operating Plan – 1 Line – 7th Avenue Local – South Ferry

Van Cortlandt Park-242 Street	238 Street	215 Street	137 Street- City College	96 Street 1 2 3	Times Sq- 42 Street	Chambers Street 1 2 3	South Ferry	South Ferry	Chambers Street 1 2 3	Times Sq- 42 Street	96 Street 1 2 3	137 Street- City College	215 Street	238 Street	Van Cortlandt Park-242 Street
0:07:00	0:08:00	0:12:00	0:23:00	0:30:00	0:40:30	0:53:00	0:57:00	1:00:00	1:03:30	1:15:00	1:25:30	1:32:00	1:44:00	1:48:30	1:50:00
0:27:00	0:28:00	0:32:00	0:43:00	0:50:00	1:00:30	1:13:00	1:17:00	1:20:00	1:23:30	1:35:00	1:45:30	1:52:00	2:04:00	2:08:30	2:10:00
0:47:00	0:48:00	0:52:00	1:03:00	1:10:00	1:20:30	1:33:00	1:37:00	1:40:00	1:43:30	1:55:00	2:05:30	2:12:00	2:24:00	2:28:30	2:30:00
1:07:00	1:08:00	1:12:00	1:23:00	1:30:00	1:40:30	1:53:00	1:57:00	2:00:00	2:03:30	2:15:00	2:25:30	2:32:00	2:44:00	2:48:30	2:50:00
1:27:00	1:28:00	1:32:00	1:43:00	1:50:00	2:00:30	2:13:00	2:17:00	2:20:00	2:23:30	2:35:00	2:45:30	2:52:00	3:04:00	3:08:30	3:10:00
1:47:00	1:48:00	1:52:00	2:03:00	2:10:00	2:20:30	2:33:00	2:37:00	2:40:00	2:43:30	2:55:00	3:05:30	3:12:00	3:24:00	3:28:30	3:30:00
2:07:00	2:08:00	2:12:00	2:23:00	2:30:00	2:40:30	2:53:00	2:57:00	3:00:00	3:03:30	3:15:00	3:25:30	3:32:00	3:44:00	3:48:30	3:50:00
2:27:00	2:28:00	2:32:00	2:43:00	2:50:00	3:00:30	3:13:00	3:17:00	3:20:00	3:23:30	3:35:00	3:45:30	3:52:00	4:04:00	4:08:30	4:10:00
2:47:00	2:48:00	2:52:00	3:03:00	3:10:00	3:20:30	3:33:00	3:37:00	3:40:00	3:43:30	3:55:00	4:05:30	4:12:00	4:24:00	4:28:30	4:30:00
3:07:00	3:08:00	3:12:00	3:23:00	3:30:00	3:40:30	3:53:00	3:57:00	4:00:00	4:03:30	4:15:00	4:25:30	4:32:00	4:44:00	4:48:30	4:50:00
3:27:00	3:28:00	3:32:00	3:43:00	3:50:00	4:00:30	4:13:00	4:17:00	4:20:00	4:23:30	4:35:00	4:45:30	4:52:00	5:04:00	5:08:30	5:10:00
3:47:00	3:48:00	3:52:00	4:03:00	4:10:00	4:20:30	4:33:00	4:37:00	4:40:00	4:43:30	4:55:00	5:05:30	5:12:00	5:24:00	5:28:30	5:30:00
4:07:00	4:08:00	4:12:00	4:23:00	4:30:00	4:40:30	4:53:00	4:57:00	5:00:00	5:03:30	5:15:00	5:25:30	5:32:00	5:44:00	5:48:30	5:50:00
4:27:00	4:28:00	4:32:00	4:43:00	4:50:00	5:00:30	5:13:00	5:17:00	5:20:00	5:23:30	5:35:00	5:45:30	5:52:00	6:04:00	6:08:30	6:10:00
4:42:00	4:43:00	4:47:00	4:58:00	5:05:00	5:15:30	5:28:00	5:32:00	5:35:00	5:38:30	5:50:00	6:00:30	6:07:00	6:19:00	6:23:30	6:25:00
4:57:00	4:58:00	5:02:00	5:13:00	5:20:00	5:30:30	5:43:00	5:47:00	5:50:00	5:53:30	6:05:00	6:15:30	6:22:00	6:34:00	6:38:30	6:40:00
5:05:00	5:06:00	5:10:00	5:21:00	5:28:00	5:38:30	5:51:00	5:55:00	5:58:00	6:01:30	6:13:30	6:24:00	6:31:00	6:43:00	6:47:30	6:49:00
5:13:00	5:14:00	5:18:00	5:29:00	5:36:00	5:46:30	5:59:00	6:03:00	6:06:00	6:09:30	6:21:30	6:32:00	6:39:00	6:51:00	6:55:30	6:57:00
5:21:00	5:22:00	5:26:00	5:37:00	5:44:00	5:54:30	6:07:00	6:11:00	6:14:00	6:17:30	6:29:30	6:40:00	6:47:00	6:59:00	7:03:30	7:05:00
5:29:00	5:30:00	5:34:00	5:45:00	5:52:00	6:02:30	6:15:00	6:19:00	6:22:00	6:25:30	6:37:30	6:48:00	6:55:00	7:07:00	7:11:30	7:13:00
-	5:38:00	5:42:00	5:53:00	6:00:00	6:10:30	6:23:00	6:27:00	6:30:00	6:33:30	6:45:30	6:56:00	7:03:00	7:15:00	7:19:30	7:21:00
5:45:00	5:46:00	5:50:00	6:01:00	6:08:00	6:18:30	6:31:00	6:35:00	6:38:00	6:41:30	6:53:30	7:04:00	7:11:00	-	-	-
5:53:00	5:54:00	5:58:00	6:09:00	6:16:00	6:26:30	6:39:00	6:43:00	6:46:00	6:49:30	7:01:30	7:12:00	7:19:00	7:31:00	7:35:30	7:37:00
6:01:00	6:02:00	6:06:00	6:17:30	6:24:30	6:35:30	6:48:00	6:52:00	6:55:00	6:59:00	7:12:00	7:22:30	7:29:30	7:41:30	7:46:00	7:47:30
6:09:00	6:10:00	6:14:00	6:25:30	6:32:30	6:43:30	6:56:00	7:00:00	7:03:00	7:07:00	7:20:00	7:30:30	7:37:30	7:49:30	7:54:00	7:55:30
-	6:14:00	6:18:00	6:29:30	6:36:30	6:47:30	7:00:00	7:04:00	7:07:00	7:11:00	7:24:00	7:34:30	7:41:30	7:53:30	7:58:00	7:59:30
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6:21:00	6:22:00	6:26:00	6:37:30	6:44:30	6:55:30	7:08:00	7:12:00	7:15:00	7:19:00	7:32:00	7:42:30	7:49:30	8:01:30	8:06:00	8:07:30
6:25:00	6:26:00	6:30:00	6:41:30	6:48:30	6:59:30	7:12:00	7:16:00	7:19:00	7:23:00	7:36:00	7:46:30	7:53:30	-	-	-
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6:37:00	6:38:00	6:42:00	6:53:30	7:00:30	7:11:30	7:24:00	7:28:00	7:31:00	7:35:00	7:48:00	7:58:30	8:05:30	8:17:30	8:22:00	8:23:30
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APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-1. Future Baseline (CBTC) Operating Plan – 1 Line – 7th Avenue Local – South Ferry

Van Cortlandt Park-242 Street	238 Street	215 Street	137 Street-City College	96 Street 1 2 3	Times Sq-42 Street	Chambers Street 1 2 3	South Ferry	South Ferry	Chambers Street 1 2 3	Times Sq-42 Street	96 Street 1 2 3	137 Street-City College	215 Street	238 Street	Van Cortlandt Park-242 Street
6:43:00	6:44:00	6:48:00	6:59:30	7:06:30	7:17:30	7:30:00	7:34:00	7:37:00	7:41:00	7:54:00	8:04:30	8:11:30	8:23:30	8:28:00	8:29:30
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6:51:00	6:52:00	6:56:30	7:08:30	7:15:30	7:26:30	7:39:30	7:43:30	7:46:30	7:50:30	8:03:30	8:14:00	8:21:00	8:33:00	8:37:30	8:39:00
-	6:54:00	6:58:30	7:10:30	7:17:30	7:28:30	7:41:30	7:45:30	7:48:30	7:52:30	8:05:30	8:16:00	8:23:00	-	-	-
6:55:00	6:56:00	7:00:30	7:12:30	7:19:30	7:30:30	7:43:30	7:47:30	7:50:30	7:54:30	8:07:30	8:18:00	8:25:00	8:37:00	8:41:30	8:43:00
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7:03:00	7:04:00	7:08:30	7:20:30	7:27:30	7:38:30	7:51:30	7:55:30	7:58:30	8:02:30	8:15:30	8:26:00	8:33:00	8:45:00	8:49:30	8:51:00
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7:27:00	7:28:00	7:32:30	7:44:30	7:51:30	8:02:30	8:15:30	8:19:30	8:22:30	8:26:30	8:39:30	8:50:00	8:57:00	9:09:00	9:13:30	9:15:00
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7:31:00	7:32:00	7:36:30	7:48:30	7:55:30	8:06:30	8:19:30	8:23:30	8:26:30	8:30:30	8:43:30	8:54:00	9:01:00	9:13:00	9:17:30	9:19:00
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7:43:00	7:44:00	7:48:30	8:00:30	8:07:30	8:18:30	8:31:30	8:35:30	8:38:30	8:42:30	8:55:30	9:06:00	9:13:00	9:25:00	9:29:30	9:31:00
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7:51:00	7:52:00	7:56:30	8:08:30	8:15:30	8:26:30	8:39:30	8:43:30	8:46:30	8:50:30	9:03:30	9:14:00	9:21:00	9:33:00	9:37:30	9:39:00
7:53:00	7:54:00	7:58:30	8:10:30	8:17:30	8:28:30	8:41:30	8:45:30	8:48:30	8:52:30	9:05:30	9:16:00	9:23:00	9:35:00	9:39:30	9:41:00

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-1. Future Baseline (CBTC) Operating Plan – 1 Line – 7th Avenue Local – South Ferry

Van Cortlandt Park-242 Street	238 Street	215 Street	137 Street-City College	96 Street 1 2 3	Times Sq-42 Street	Chambers Street 1 2 3	South Ferry	South Ferry	Chambers Street 1 2 3	Times Sq-42 Street	96 Street 1 2 3	137 Street-City College	215 Street	238 Street	Van Cortlandt Park-242 Street
-	7:56:00	8:00:30	8:12:30	8:19:30	8:30:30	8:43:30	8:47:30	8:50:30	8:54:30	9:07:30	9:18:00	9:25:00	9:37:00	9:41:30	9:43:00
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7:59:00	8:00:00	8:04:30	8:16:30	8:23:30	8:34:30	8:47:30	8:51:30	8:54:30	8:58:30	9:11:30	9:22:00	9:29:00	9:41:00	9:45:30	-
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8:15:00	8:16:00	8:20:30	8:32:30	8:39:30	8:50:30	9:03:30	9:07:30	9:10:30	9:14:00	9:26:00	9:36:30	9:43:30	9:55:30	10:00:00	10:01:30
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8:43:00	8:44:00	8:48:00	8:59:30	9:06:30	9:17:30	9:30:00	9:34:00	9:37:00	9:40:30	9:52:30	10:03:00	10:10:00	10:22:00	10:26:30	10:28:00
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9:15:00	9:16:00	9:20:00	9:31:30	9:38:30	9:49:30	10:02:00	10:06:00	10:09:00	10:12:30	10:24:00	10:34:30	10:41:00	10:53:00	10:57:30	10:59:00
9:19:00	9:20:00	9:24:00	9:35:30	9:42:30	9:53:30	10:06:00	10:10:00	10:13:00	10:16:30	10:28:00	10:38:30	10:45:00	10:57:00	11:01:30	11:03:00
-	-	-	9:37:30	9:44:30	9:55:30	10:08:00	10:12:00	10:15:00	10:18:30	10:30:00	10:40:30	10:47:00	10:59:00	11:03:30	11:05:00
9:23:00	9:24:00	9:28:00	9:39:30	9:46:30	9:57:30	10:10:00	10:14:00	10:17:00	10:20:30	10:32:00	10:42:30	10:49:00	11:01:00	11:05:30	11:07:00
9:27:00	9:28:00	9:32:00	9:43:30	9:50:30	10:01:30	10:14:00	10:18:00	10:21:00	10:24:30	10:36:00	10:46:30	10:53:00	11:05:00	11:09:30	11:11:00

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-1. Future Baseline (CBTC) Operating Plan – 1 Line – 7th Avenue Local – South Ferry

Van Cortlandt Park-242 Street	238 Street	215 Street	137 Street-City College	96 Street 1 2 3	Times Sq-42 Street	Chambers Street 1 2 3	South Ferry	South Ferry	Chambers Street 1 2 3	Times Sq-42 Street	96 Street 1 2 3	137 Street-City College	215 Street	238 Street	Van Cortlandt Park-242 Street
9:31:00	9:32:00	9:36:00	9:47:30	9:54:30	10:05:30	10:18:00	10:22:00	10:25:00	10:28:30	10:40:00	10:50:30	10:57:00	11:09:00	11:13:30	11:15:00
-	-	-	9:49:30	9:56:30	10:07:30	10:20:00	10:24:00	10:27:00	10:30:30	10:42:00	10:52:30	10:59:00	11:11:00	11:15:30	-
9:35:00	9:36:00	9:40:00	9:51:30	9:58:30	10:09:30	10:22:00	10:26:00	10:29:00	10:32:30	10:44:00	10:54:30	11:01:00	11:13:00	11:17:30	11:19:00
9:39:00	9:40:00	9:44:00	9:55:30	10:02:30	10:13:30	10:26:00	10:30:00	10:33:00	10:36:30	10:48:00	10:58:30	11:05:00	11:17:00	11:21:30	11:23:00
9:43:00	9:44:00	9:48:00	9:59:30	10:06:30	10:17:30	10:30:00	10:34:00	10:37:00	10:40:30	10:52:00	11:02:30	11:09:00	11:21:00	11:25:30	11:27:00
9:47:00	9:48:00	9:52:00	10:03:30	10:10:30	10:21:30	10:34:00	10:38:00	10:41:00	10:44:30	10:56:00	11:06:30	11:13:00	11:25:00	11:29:30	11:31:00
9:51:00	9:52:00	9:56:00	10:07:30	10:14:30	10:25:30	10:38:00	10:42:00	10:45:00	10:48:30	11:00:00	11:10:30	11:17:00	11:29:00	11:33:30	11:35:00
9:55:00	9:56:00	10:00:00	10:11:30	10:18:30	10:29:30	10:42:00	10:46:00	10:49:00	10:52:30	11:04:00	11:14:30	11:21:00	11:33:00	11:37:30	11:39:00
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9:59:00	10:00:00	10:04:00	10:15:00	10:22:00	10:32:30	10:45:00	10:49:00	10:52:00	10:55:30	11:07:00	11:17:30	11:24:00	11:36:00	11:40:30	11:42:00
10:03:00	10:04:00	10:08:00	10:19:00	10:26:00	10:36:30	10:49:00	10:53:00	10:56:00	10:59:30	11:11:00	11:21:30	11:28:00	11:40:00	11:44:30	11:46:00
10:07:00	10:08:00	10:12:00	10:23:00	10:30:00	10:40:30	10:53:00	10:57:00	11:00:00	11:03:30	11:15:00	11:25:30	11:32:00	11:44:00	11:48:30	11:50:00
10:11:00	10:12:00	10:16:00	10:27:00	10:34:00	10:44:30	10:57:00	11:01:00	11:04:00	11:07:30	11:19:00	11:29:30	11:36:00	11:48:00	11:52:30	11:54:00
10:15:00	10:16:00	10:20:00	10:31:00	10:38:00	10:48:30	11:01:00	11:05:00	11:08:00	11:11:30	11:23:00	11:33:30	11:40:00	11:52:00	11:56:30	11:58:00
10:19:00	10:20:00	10:24:00	10:35:00	10:42:00	10:52:30	11:05:00	11:09:00	11:12:00	11:15:30	11:27:00	11:37:30	11:44:00	11:56:00	12:00:30	12:02:00
10:23:00	10:24:00	10:28:00	10:39:00	10:46:00	10:56:30	11:09:00	11:13:00	11:16:00	11:19:30	11:31:00	11:41:30	11:48:00	12:00:00	12:04:30	12:06:00
10:27:00	10:28:00	10:32:00	10:43:00	10:50:00	11:00:30	11:13:00	11:17:00	11:20:00	11:23:30	11:35:00	11:45:30	11:52:00	12:04:00	12:08:30	12:10:00
10:31:00	10:32:00	10:36:00	10:47:00	10:54:00	11:04:30	11:17:00	11:21:00	11:24:00	11:27:30	11:39:00	11:49:30	11:56:00	12:08:00	12:12:30	12:14:00
10:35:00	10:36:00	10:40:00	10:51:00	10:58:00	11:08:30	11:21:00	11:25:00	11:28:00	11:31:30	11:43:00	11:53:30	12:00:00	12:12:00	12:16:30	12:18:00
10:39:00	10:40:00	10:44:00	10:55:00	11:02:00	11:12:30	11:25:00	11:29:00	11:32:00	11:35:30	11:47:00	11:57:30	12:04:00	12:16:00	12:20:30	12:22:00
10:43:00	10:44:00	10:48:00	10:59:00	11:06:00	11:16:30	11:29:00	11:33:00	11:36:00	11:39:30	11:51:00	12:01:30	12:08:00	12:20:00	12:24:30	12:26:00
10:47:00	10:48:00	10:52:00	11:03:00	11:10:00	11:20:30	11:33:00	11:37:00	11:40:00	11:43:30	11:55:00	12:05:30	12:12:00	12:24:00	12:28:30	12:30:00
10:51:00	10:52:00	10:56:00	11:07:00	11:14:00	11:24:30	11:37:00	11:41:00	11:44:00	11:47:30	11:59:00	12:09:30	12:16:00	12:28:00	12:32:30	12:34:00
10:55:00	10:56:00	11:00:00	11:11:00	11:18:00	11:28:30	11:41:00	11:45:00	11:48:00	11:51:30	12:03:00	12:13:30	12:20:00	12:32:00	12:36:30	12:38:00
10:59:00	11:00:00	11:04:00	11:15:00	11:22:00	11:32:30	11:45:00	11:49:00	11:52:00	11:55:30	12:07:00	12:17:30	12:24:00	12:36:00	12:40:30	12:42:00
11:03:00	11:04:00	11:08:00	11:19:00	11:26:00	11:36:30	11:49:00	11:53:00	11:56:00	11:59:30	12:11:00	12:21:30	12:28:00	12:40:00	12:44:30	12:46:00
11:07:00	11:08:00	11:12:00	11:23:00	11:30:00	11:40:30	11:53:00	11:57:00	12:00:00	12:03:30	12:15:00	12:25:30	12:32:00	12:44:00	12:48:30	12:50:00
11:11:00	11:12:00	11:16:00	11:27:00	11:34:00	11:44:30	11:57:00	12:01:00	12:04:00	12:07:30	12:19:00	12:29:30	12:36:00	12:48:00	12:52:30	12:54:00
11:15:00	11:16:00	11:20:00	11:31:00	11:38:00	11:48:30	12:01:00	12:05:00	12:08:00	12:11:30	12:23:00	12:33:30	12:40:00	12:52:00	12:56:30	12:58:00
11:19:00	11:20:00	11:24:00	11:35:00	11:42:00	11:52:30	12:05:00	12:09:00	12:12:00	12:15:30	12:27:00	12:37:30	12:44:00	12:56:00	13:00:30	13:02:00
11:23:00	11:24:00	11:28:00	11:39:00	11:46:00	11:56:30	12:09:00	12:13:00	12:16:00	12:19:30	12:31:00	12:41:30	12:48:00	13:00:00	13:04:30	13:06:00
11:29:00	11:30:00	11:34:00	11:45:00	11:52:00	12:02:30	12:15:00	12:19:00	12:22:00	12:25:30	12:37:00	12:47:30	12:54:00	13:06:00	13:10:30	13:12:00
11:35:00	11:36:00	11:40:00	11:51:00	11:58:00	12:08:30	12:21:00	12:25:00	12:28:00	12:31:30	12:43:00	12:53:30	13:00:00	13:12:00	13:16:30	13:18:00
11:41:00	11:42:00	11:46:00	11:57:00	12:04:00	12:14:30	12:27:00	12:31:00	12:34:00	12:37:30	12:49:00	12:59:30	13:06:00	13:18:00	13:22:30	13:24:00
11:47:00	11:48:00	11:52:00	12:03:00	12:10:00	12:20:30	12:33:00	12:37:00	12:40:00	12:43:30	12:55:00	13:05:30	13:12:00	13:24:00	13:28:30	13:30:00
11:53:00	11:54:00	11:58:00	12:09:00	12:16:00	12:26:30	12:39:00	12:43:00	12:46:00	12:49:30	13:01:00	13:11:30	13:18:00	13:30:00	13:34:30	13:36:00

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-1. Future Baseline (CBTC) Operating Plan – 1 Line – 7th Avenue Local – South Ferry

Van Cortlandt Park-242 Street	238 Street	215 Street	137 Street-City College	96 Street 1 2 3	Times Sq-42 Street	Chambers Street 1 2 3	South Ferry	South Ferry	Chambers Street 1 2 3	Times Sq-42 Street	96 Street 1 2 3	137 Street-City College	215 Street	238 Street	Van Cortlandt Park-242 Street
11:59:00	12:00:00	12:04:00	12:15:00	12:22:00	12:32:30	12:45:00	12:49:00	12:52:00	12:55:30	13:07:00	13:17:30	13:24:00	13:36:00	13:40:30	13:42:00
12:05:00	12:06:00	12:10:00	12:21:00	12:28:00	12:38:30	12:51:00	12:55:00	12:58:00	13:01:30	13:13:00	13:23:30	13:30:00	13:42:00	13:46:30	13:48:00
12:11:00	12:12:00	12:16:00	12:27:00	12:34:00	12:44:30	12:57:00	13:01:00	13:04:00	13:07:30	13:19:00	13:29:30	13:36:00	13:48:00	13:52:30	13:54:00
12:17:00	12:18:00	12:22:00	12:33:00	12:40:00	12:50:30	13:03:00	13:07:00	13:10:00	13:13:30	13:25:00	13:35:30	13:42:00	13:54:00	13:58:30	14:00:00
12:23:00	12:24:00	12:28:00	12:39:00	12:46:00	12:56:30	13:09:00	13:13:00	13:16:00	13:19:30	13:31:00	13:41:30	13:48:00	14:00:00	14:04:30	14:06:00
12:29:00	12:30:00	12:34:00	12:45:00	12:52:00	13:02:30	13:15:00	13:19:00	13:22:00	13:25:30	13:37:00	13:47:30	13:54:00	14:06:00	14:10:30	14:12:00
12:35:00	12:36:00	12:40:00	12:51:00	12:58:00	13:08:30	13:21:00	13:25:00	13:28:00	13:31:30	13:43:00	13:53:30	14:00:00	14:12:00	14:16:30	14:18:00
12:41:00	12:42:00	12:46:00	12:57:00	13:04:00	13:14:30	13:27:00	13:31:00	13:34:00	13:37:30	13:49:00	13:59:30	14:06:00	14:18:00	14:22:30	14:24:00
12:47:00	12:48:00	12:52:00	13:03:00	13:10:00	13:20:30	13:33:00	13:37:00	13:40:00	13:43:30	13:55:00	14:05:30	14:12:00	14:24:00	14:28:30	14:30:00
12:53:00	12:54:00	12:58:00	13:09:00	13:16:00	13:26:30	13:39:00	13:43:00	13:46:00	13:49:30	14:01:00	14:11:30	14:18:00	14:30:00	14:34:30	14:36:00
12:59:00	13:00:00	13:04:00	13:15:00	13:22:00	13:32:30	13:45:00	13:49:00	13:52:00	13:55:30	14:07:00	14:17:30	14:24:00	14:36:00	14:40:30	14:42:00
13:05:00	13:06:00	13:10:00	13:21:00	13:28:00	13:38:30	13:51:00	13:55:00	13:58:00	14:01:30	14:13:00	14:23:30	14:30:00	14:42:00	14:46:30	14:48:00
13:11:00	13:12:00	13:16:00	13:27:00	13:34:00	13:44:30	13:57:00	14:01:00	14:04:00	14:07:30	14:19:00	14:29:30	14:36:00	14:48:00	14:52:30	14:54:00
13:17:00	13:18:00	13:22:00	13:33:00	13:40:00	13:50:30	14:03:00	14:07:00	14:10:00	14:13:30	14:25:00	14:35:30	14:42:00	14:54:00	14:58:30	15:00:00
13:23:00	13:24:00	13:28:00	13:39:00	13:46:00	13:56:30	14:09:00	14:13:00	14:16:00	14:19:30	14:31:00	14:41:30	14:48:00	15:00:00	15:04:30	15:06:00
13:29:00	13:30:00	13:34:00	13:45:00	13:52:00	14:02:30	14:15:00	14:19:00	14:22:00	14:25:30	14:37:00	14:47:30	14:54:00	15:06:00	15:10:30	15:12:00
13:35:00	13:36:00	13:40:00	13:51:00	13:58:00	14:08:30	14:21:00	14:25:00	14:28:00	14:31:30	14:43:00	14:53:30	15:00:00	15:12:00	15:16:30	15:18:00
13:41:00	13:42:00	13:46:00	13:57:00	14:04:00	14:14:30	14:27:00	14:31:00	14:34:00	14:37:30	14:49:00	14:59:30	15:06:00	15:18:00	15:22:30	15:24:00
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13:53:00	13:54:00	13:58:00	14:09:00	14:16:00	14:26:30	14:39:00	14:43:00	14:46:00	14:49:30	15:01:00	15:11:30	15:18:00	15:30:00	15:34:30	15:36:00
13:59:00	14:00:00	14:04:00	14:15:00	14:22:00	14:32:30	14:45:00	14:49:00	14:52:00	14:55:30	15:07:00	15:17:30	15:24:00	15:36:00	15:40:30	15:42:00
14:05:00	14:06:00	14:10:00	14:21:00	14:28:00	14:38:30	14:51:00	14:55:00	14:58:00	15:01:30	15:13:30	15:24:00	15:31:00	15:43:00	15:47:30	15:49:00
14:11:00	14:12:00	14:16:00	14:27:00	14:34:00	14:44:30	14:57:00	15:01:00	15:04:00	15:07:30	15:19:30	15:30:00	15:37:00	15:49:00	15:53:30	15:55:00
14:17:00	14:18:00	14:22:00	14:33:00	14:40:00	14:50:30	15:03:00	15:07:00	15:10:00	15:13:30	15:25:30	15:36:00	15:43:00	15:55:00	15:59:30	16:01:00
14:23:00	14:24:00	14:28:00	14:39:00	14:46:00	14:56:30	15:09:00	15:13:00	15:16:00	15:19:30	15:31:30	15:42:00	15:49:00	16:01:00	16:05:30	16:07:00
14:29:00	14:30:00	14:34:00	14:45:00	14:52:00	15:02:30	15:15:00	15:19:00	15:22:00	15:25:30	15:37:30	15:48:00	15:55:00	16:07:00	16:11:30	16:13:00
14:35:00	14:36:00	14:40:00	14:51:00	14:58:00	15:08:30	15:21:00	15:25:00	15:28:00	15:31:30	15:43:30	15:54:00	16:01:00	16:13:00	16:17:30	16:19:00
14:41:00	14:42:00	14:46:00	14:57:00	15:04:00	15:14:30	15:27:00	15:31:00	15:34:00	15:37:30	15:49:30	16:00:00	16:07:00	16:19:00	16:23:30	16:25:00
14:47:00	14:48:00	14:52:00	15:03:00	15:10:00	15:20:30	15:33:00	15:37:00	15:40:00	15:43:30	15:55:30	16:06:00	16:13:00	16:25:00	16:29:30	16:31:00
14:50:00	14:51:00	14:55:00	15:06:00	15:13:00	15:23:30	15:36:00	15:40:00	15:43:00	15:46:30	15:58:30	16:09:00	16:16:00	16:28:00	16:32:30	16:34:00
14:53:00	14:54:00	14:58:00	15:09:00	15:16:00	15:26:30	15:39:00	15:43:00	15:46:00	15:49:30	16:01:30	16:12:00	16:19:00	16:31:00	-	-
14:59:00	15:00:00	15:04:00	15:15:00	15:22:00	15:32:30	15:45:00	15:49:00	15:52:00	15:55:30	16:07:30	16:18:00	16:25:00	16:37:00	16:41:30	16:43:00
15:03:00	15:04:00	15:08:00	15:19:30	15:26:30	15:37:30	15:50:00	15:54:00	15:57:00	16:01:00	16:14:00	16:24:30	16:31:30	16:43:30	16:48:00	16:49:30
15:07:00	15:08:00	15:12:00	15:23:30	15:30:30	15:41:30	15:54:00	15:58:00	16:02:00	16:06:00	16:19:00	16:29:30	16:36:30	16:48:30	16:53:00	16:54:30
15:11:00	15:12:00	15:16:00	15:27:30	15:34:30	15:45:30	15:58:00	16:02:00	16:05:00	16:09:00	16:22:00	16:32:30	16:39:30	16:51:30	-	-
15:15:00	15:16:00	15:20:00	15:31:30	15:38:30	15:49:30	16:02:00	16:06:00	16:09:00	16:13:00	16:26:00	16:36:30	16:43:30	16:55:30	17:00:00	17:01:30

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-1. Future Baseline (CBTC) Operating Plan – 1 Line – 7th Avenue Local – South Ferry

Van Cortlandt Park-242 Street	238 Street	215 Street	137 Street-City College	96 Street 1 2 3	Times Sq-42 Street	Chambers Street 1 2 3	South Ferry	South Ferry	Chambers Street 1 2 3	Times Sq-42 Street	96 Street 1 2 3	137 Street-City College	215 Street	238 Street	Van Cortlandt Park-242 Street
15:19:00	15:20:00	15:24:00	15:35:30	15:42:30	15:53:30	16:06:00	16:10:00	16:13:00	16:17:00	16:30:00	16:40:30	16:47:30	16:59:30	17:04:00	17:05:30
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15:27:00	15:28:00	15:32:00	15:43:30	15:50:30	16:01:30	16:14:00	16:18:00	16:22:00	16:26:00	16:39:00	16:49:30	16:56:30	17:08:30	17:13:00	17:14:30
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APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-1. Future Baseline (CBTC) Operating Plan – 1 Line – 7th Avenue Local – South Ferry

Van Cortlandt Park-242 Street	238 Street	215 Street	137 Street-City College	96 Street 1 2 3	Times Sq-42 Street	Chambers Street 1 2 3	South Ferry	South Ferry	Chambers Street 1 2 3	Times Sq-42 Street	96 Street 1 2 3	137 Street-City College	215 Street	238 Street	Van Cortlandt Park-242 Street
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APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-1. Future Baseline (CBTC) Operating Plan – 1 Line – 7th Avenue Local – South Ferry

Van Cortlandt Park-242 Street	238 Street	215 Street	137 Street-City College	96 Street 1 2 3	Times Sq-42 Street	Chambers Street 1 2 3	South Ferry	South Ferry	Chambers Street 1 2 3	Times Sq-42 Street	96 Street 1 2 3	137 Street-City College	215 Street	238 Street	Van Cortlandt Park-242 Street
-	-	18:12:00	18:23:30	18:30:30	18:41:30	18:54:00	18:58:00	19:01:00	19:04:30	19:16:00	19:26:30	19:33:00	19:45:00	19:49:30	19:51:00
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18:45:00	18:46:00	18:50:00	19:01:30	19:08:30	19:19:30	19:32:00	19:36:00	19:39:00	19:42:30	19:54:00	20:04:30	20:11:00	20:23:00	20:27:30	20:29:00
18:49:00	18:50:00	18:54:00	19:05:30	19:12:30	19:23:30	19:36:00	19:40:00	19:43:00	19:46:30	19:58:00	20:08:30	20:15:00	20:27:00	20:31:30	20:33:00
18:53:00	18:54:00	18:58:00	19:09:30	19:16:30	19:27:30	19:40:00	19:44:00	19:47:00	19:50:30	20:02:00	20:12:30	20:19:00	20:31:00	20:35:30	20:37:00
-	-	19:00:00	19:11:30	19:18:30	19:29:30	19:42:00	19:46:00	19:49:00	19:52:30	20:04:00	20:14:30	20:21:00	20:33:00	20:37:30	-
18:57:00	18:58:00	19:02:00	19:13:30	19:20:30	19:31:30	19:44:00	19:48:00	19:51:00	19:54:30	20:06:00	20:16:30	20:23:00	20:35:00	20:39:30	20:41:00
19:01:00	19:02:00	19:06:00	19:17:00	19:24:00	19:34:30	19:47:00	19:51:00	19:54:00	19:57:30	20:09:00	20:19:30	20:26:00	20:38:00	20:42:30	20:44:00
19:05:00	19:06:00	19:10:00	19:21:00	19:28:00	19:38:30	19:51:00	19:55:00	19:58:00	20:01:30	20:13:00	20:23:30	20:30:00	20:42:00	20:46:30	20:48:00
19:09:00	19:10:00	19:14:00	19:25:00	19:32:00	19:42:30	19:55:00	19:59:00	20:02:00	20:05:30	20:17:00	20:27:30	20:34:00	20:46:00	20:50:30	20:52:00
-	-	19:17:00	19:28:30	19:35:30	19:46:00	19:58:30	20:02:30	20:06:00	20:09:30	20:21:00	20:31:30	20:38:00	20:50:00	20:54:30	-
19:15:00	19:16:00	19:20:00	19:31:00	19:38:00	19:48:30	20:01:00	20:05:00	20:10:00	20:13:30	20:25:00	20:35:30	20:42:00	20:54:00	20:58:30	21:00:00
19:21:00	19:22:00	19:26:00	19:37:00	19:44:00	19:54:30	20:07:00	20:11:00	20:14:00	20:17:30	20:29:00	20:39:30	20:46:00	20:58:00	21:02:30	21:04:00
19:25:00	19:26:00	19:30:00	19:41:00	19:48:00	19:58:30	20:11:00	20:15:00	20:18:00	20:21:30	20:33:00	20:43:30	20:50:00	21:02:00	21:06:30	-
-	-	19:32:00	19:43:30	19:50:30	20:01:00	20:13:30	20:17:30	20:20:30	20:24:00	20:35:30	20:46:00	20:52:30	21:04:30	21:09:00	21:10:30
19:29:00	19:30:00	19:34:00	19:45:00	19:52:00	20:02:30	20:15:00	20:19:00	20:22:00	20:25:30	20:37:00	20:47:30	20:54:00	21:06:00	21:10:30	21:12:00
19:33:00	19:34:00	19:38:00	19:49:00	19:56:00	20:06:30	20:19:00	20:23:00	20:26:00	20:29:30	20:41:00	20:51:30	20:58:00	21:10:00	21:14:30	21:16:00
19:37:00	19:38:00	19:42:00	19:53:00	20:00:00	20:10:30	20:23:00	20:27:00	20:30:00	20:33:30	20:45:00	20:55:30	21:02:00	21:14:00	21:18:30	-
19:41:00	19:42:00	19:46:00	19:57:00	20:04:00	20:14:30	20:27:00	20:31:00	20:34:00	20:37:30	20:49:00	20:59:30	21:06:00	21:18:00	21:22:30	21:24:00
19:45:00	19:46:00	19:50:00	20:01:00	20:08:00	20:18:30	20:31:00	20:35:00	20:38:00	20:41:30	20:53:00	21:03:30	21:10:00	21:22:00	21:26:30	21:28:00
19:49:00	19:50:00	19:54:00	20:05:00	20:12:00	20:22:30	20:35:00	20:39:00	20:42:00	20:45:30	20:57:00	21:07:30	21:14:00	21:26:00	21:30:30	21:32:00
19:53:00	19:54:00	19:58:00	20:09:00	20:16:00	20:26:30	20:39:00	20:43:00	20:46:00	20:49:30	21:01:00	21:11:30	21:18:00	21:30:00	21:34:30	21:36:00
19:57:00	19:58:00	20:02:00	20:13:00	20:20:00	20:30:30	20:43:00	20:47:00	20:50:00	20:53:30	21:05:00	21:15:30	21:22:00	21:34:00	21:38:30	21:40:00
20:01:00	20:02:00	20:06:00	20:17:00	20:24:00	20:34:30	20:47:00	20:51:00	20:54:00	20:57:30	21:09:00	21:19:30	21:26:00	21:38:00	21:42:30	21:44:00
20:05:00	20:06:00	20:10:00	20:21:00	20:28:00	20:38:30	20:51:00	20:55:00	20:58:00	21:01:30	21:13:00	21:23:30	21:30:00	21:42:00	21:46:30	21:48:00
20:09:00	20:10:00	20:14:00	20:25:00	20:32:00	20:42:30	20:55:00	20:59:00	21:02:00	21:05:30	21:17:00	21:27:30	21:34:00	21:46:00	21:50:30	21:52:00

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-1. Future Baseline (CBTC) Operating Plan – 1 Line – 7th Avenue Local – South Ferry

Van Cortlandt Park-242 Street	238 Street	215 Street	137 Street-City College	96 Street 1 2 3	Times Sq-42 Street	Chambers Street 1 2 3	South Ferry	South Ferry	Chambers Street 1 2 3	Times Sq-42 Street	96 Street 1 2 3	137 Street-City College	215 Street	238 Street	Van Cortlandt Park-242 Street
20:13:00	20:14:00	20:18:00	20:29:00	20:36:00	20:46:30	20:59:00	21:03:00	21:06:00	21:09:30	21:21:00	21:31:30	21:38:00	21:50:00	21:54:30	-
20:17:00	20:18:00	20:22:00	20:33:00	20:40:00	20:50:30	21:03:00	21:07:00	21:10:00	21:13:30	21:25:00	21:35:30	21:42:00	21:54:00	21:58:30	22:00:00
20:21:00	20:22:00	20:26:00	20:37:00	20:44:00	20:54:30	21:07:00	21:11:00	21:14:00	21:17:30	21:29:00	21:39:30	21:46:00	21:58:00	22:02:30	22:04:00
20:25:00	20:26:00	20:30:00	20:41:00	20:48:00	20:58:30	21:11:00	21:15:00	21:18:00	21:21:30	21:33:00	21:43:30	21:50:00	22:02:00	22:06:30	22:08:00
20:29:00	20:30:00	20:34:00	20:45:00	20:52:00	21:02:30	21:15:00	21:19:00	21:22:00	21:25:30	21:37:00	21:47:30	21:54:00	22:06:00	22:10:30	-
20:33:00	20:34:00	20:38:00	20:49:00	20:56:00	21:06:30	21:19:00	21:23:00	21:26:00	21:29:30	21:41:00	21:51:30	21:58:00	22:10:00	22:14:30	22:16:00
20:37:00	20:38:00	20:42:00	20:53:00	21:00:00	21:10:30	21:23:00	21:27:00	21:30:00	21:33:30	21:45:00	21:55:30	22:02:00	22:14:00	22:18:30	22:20:00
20:41:00	20:42:00	20:46:00	20:57:00	21:04:00	21:14:30	21:27:00	21:31:00	21:34:00	21:37:30	21:49:00	21:59:30	22:06:00	22:18:00	22:22:30	22:24:00
20:47:00	20:48:00	20:52:00	21:03:00	21:10:00	21:20:30	21:33:00	21:37:00	21:40:00	21:43:30	21:55:00	22:05:30	22:12:00	22:24:00	22:28:30	-
20:53:00	20:54:00	20:58:00	21:09:00	21:16:00	21:26:30	21:39:00	21:43:00	21:46:00	21:49:30	22:01:00	22:11:30	22:18:00	22:30:00	22:34:30	22:36:00
20:59:00	21:00:00	21:04:00	21:15:00	21:22:00	21:32:30	21:45:00	21:49:00	21:52:00	21:55:30	22:07:00	22:17:30	22:24:00	22:36:00	22:40:30	22:42:00
21:05:00	21:06:00	21:10:00	21:21:00	21:28:00	21:38:30	21:51:00	21:55:00	21:58:00	22:01:30	22:13:00	22:23:30	22:30:00	22:42:00	22:46:30	22:48:00
21:11:00	21:12:00	21:16:00	21:27:00	21:34:00	21:44:30	21:57:00	22:01:00	22:04:00	22:07:30	22:19:00	22:29:30	22:36:00	22:48:00	22:52:30	22:54:00
21:17:00	21:18:00	21:22:00	21:33:00	21:40:00	21:50:30	22:03:00	22:07:00	22:10:00	22:13:30	22:25:00	22:35:30	22:42:00	22:54:00	22:58:30	23:00:00
21:23:00	21:24:00	21:28:00	21:39:00	21:46:00	21:56:30	22:09:00	22:13:00	22:16:00	22:19:30	22:31:00	22:41:30	22:48:00	23:00:00	23:04:30	23:06:00
21:29:00	21:30:00	21:34:00	21:45:00	21:52:00	22:02:30	22:15:00	22:19:00	22:22:00	22:25:30	22:37:00	22:47:30	22:54:00	23:06:00	23:10:30	23:12:00
21:35:00	21:36:00	21:40:00	21:51:00	21:58:00	22:08:30	22:21:00	22:25:00	22:28:00	22:31:30	22:43:00	22:53:30	23:00:00	23:12:00	23:16:30	23:18:00
21:41:00	21:42:00	21:46:00	21:57:00	22:04:00	22:14:30	22:27:00	22:31:00	22:34:00	22:37:30	22:49:00	22:59:30	23:06:00	23:18:00	23:22:30	23:24:00
21:47:00	21:48:00	21:52:00	22:03:00	22:10:00	22:20:30	22:33:00	22:37:00	22:40:00	22:43:30	22:55:00	23:05:30	23:12:00	23:24:00	23:28:30	23:30:00
21:53:00	21:54:00	21:58:00	22:09:00	22:16:00	22:26:30	22:39:00	22:43:00	22:46:00	22:49:30	23:01:00	23:11:30	23:18:00	23:30:00	23:34:30	23:36:00
21:59:00	22:00:00	22:04:00	22:15:00	22:22:00	22:32:30	22:45:00	22:49:00	22:52:00	22:55:30	23:07:00	23:17:30	23:24:00	23:36:00	23:40:30	23:42:00
22:05:00	22:06:00	22:10:00	22:21:00	22:28:00	22:38:30	22:51:00	22:55:00	22:58:00	23:01:30	23:13:00	23:23:30	23:30:00	23:42:00	23:46:30	23:48:00
22:15:00	22:16:00	22:20:00	22:31:00	22:38:00	22:48:30	23:01:00	23:05:00	23:08:00	23:11:30	23:23:00	23:33:30	23:40:00	23:52:00	23:56:30	23:58:00
22:25:00	22:26:00	22:30:00	22:41:00	22:48:00	22:58:30	23:11:00	23:15:00	23:18:00	23:21:30	23:33:00	23:43:30	23:50:00	24:02:00	24:06:30	24:08:00
22:35:00	22:36:00	22:40:00	22:51:00	22:58:00	23:08:30	23:21:00	23:25:00	23:28:00	23:31:30	23:43:00	23:53:30	24:00:00	24:12:00	24:16:30	24:18:00
22:45:00	22:46:00	22:50:00	23:01:00	23:08:00	23:18:30	23:31:00	23:35:00	23:38:00	23:41:30	23:53:00	24:03:30	24:10:00	24:22:00	24:26:30	24:28:00
22:55:00	22:56:00	23:00:00	23:11:00	23:18:00	23:28:30	23:41:00	23:45:00	23:48:00	23:51:30	24:03:00	24:13:30	24:20:00	24:32:00	24:36:30	24:38:00
23:05:00	23:06:00	23:10:00	23:21:00	23:28:00	23:38:30	23:51:00	23:55:00	23:58:00	24:01:30	24:13:00	24:23:30	24:30:00	24:42:00	24:46:30	24:48:00
23:15:00	23:16:00	23:20:00	23:31:00	23:38:00	23:48:30	24:01:00	24:05:00	24:08:00	24:11:30	24:23:00	24:33:30	24:40:00	24:52:00	24:56:30	24:58:00
23:25:00	23:26:00	23:30:00	23:41:00	23:48:00	23:58:30	24:11:00	24:15:00	24:18:00	24:21:30	24:33:00	24:43:30	24:50:00	25:02:00	25:06:30	25:08:00
23:35:00	23:36:00	23:40:00	23:51:00	23:58:00	24:08:30	24:21:00	24:25:00	24:28:00	24:31:30	24:43:00	24:53:30	25:00:00	25:12:00	25:16:30	25:18:00
23:45:00	23:46:00	23:50:00	24:01:00	24:08:00	24:18:30	24:31:00	24:35:00	24:38:00	24:41:30	24:53:00	25:03:30	25:10:00	25:22:00	25:26:30	25:28:00
23:55:00	23:56:00	24:00:00	24:11:00	24:18:00	24:28:30	24:41:00	24:45:00	24:48:00	24:51:30	25:03:00	25:13:30	25:20:00	25:32:00	25:36:30	25:38:00
24:05:00	24:06:00	24:10:00	24:21:00	24:28:00	24:38:30	24:51:00	24:55:00	24:58:00	25:01:30	25:13:00	25:23:30	25:30:00	25:42:00	25:46:30	25:48:00
24:15:00	24:16:00	24:20:00	24:31:00	24:38:00	24:48:30	25:01:00	25:05:00	25:08:00	25:11:30	25:23:00	25:33:30	25:40:00	25:52:00	25:56:30	25:58:00
24:25:00	24:26:00	24:30:00	24:41:00	24:48:00	24:58:30	25:11:00	25:15:00	25:18:00	25:21:30	25:33:00	25:43:30	25:50:00	26:02:00	26:06:30	26:08:00

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-1. Future Baseline (CBTC) Operating Plan – ① Line – 7th Avenue Local – South Ferry

Van Cortlandt Park-242 Street	238 Street	215 Street	137 Street- City College	96 Street ① ② ③	Times Sq- 42 Street	Chambers Street ① ② ③	South Ferry	South Ferry	Chambers Street ① ② ③	Times Sq- 42 Street	96 Street ① ② ③	137 Street- City College	215 Street	238 Street	Van Cortlandt Park-242 Street
24:35:00	24:36:00	24:40:00	24:51:00	24:58:00	25:08:30	25:21:00	25:25:00	25:28:00	25:31:30	25:43:00	25:53:30	26:00:00	26:12:00	26:16:30	26:18:00
24:45:00	24:46:00	24:50:00	25:01:00	25:08:00	25:18:30	25:31:00	25:35:00	25:38:00	25:41:30	25:53:00	26:03:30	26:10:00	26:22:00	26:26:30	26:28:00
24:55:00	24:56:00	25:00:00	25:11:00	25:18:00	25:28:30	25:41:00	25:45:00	25:48:00	25:51:30	26:03:00	26:13:30	26:20:00	26:32:00	26:36:30	26:38:00
25:05:00	25:06:00	25:10:00	25:21:00	25:28:00	25:38:30	25:51:00	25:55:00	25:58:00	26:01:30	26:13:00	26:23:30	26:30:00	26:42:00	26:46:30	26:48:00
25:15:00	25:16:00	25:20:00	25:31:00	25:38:00	25:48:30	26:01:00	26:05:00	26:08:00	26:11:30	26:23:00	26:33:30	26:40:00	26:52:00	26:56:30	26:58:00
25:25:00	25:26:00	25:30:00	25:41:00	25:48:00	25:58:30	26:11:00	26:15:00	26:18:00	26:21:30	26:33:00	26:43:30	26:50:00	27:02:00	27:06:30	27:08:00
25:35:00	25:36:00	25:40:00	25:51:00	25:58:00	26:08:30	26:21:00	26:25:00	26:28:00	26:31:30	26:43:00	26:53:30	27:00:00	27:12:00	27:16:30	27:18:00
25:45:00	25:46:00	25:50:00	26:01:00	26:08:00	26:18:30	26:31:00	26:35:00	26:38:00	26:41:30	26:53:00	27:03:30	27:10:00	27:22:00	27:26:30	27:28:00
25:55:00	25:56:00	26:00:00	26:11:00	26:18:00	26:28:30	26:41:00	26:45:00	26:48:00	26:51:30	27:03:00	27:13:30	27:20:00	27:32:00	27:36:30	27:38:00

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

G.2.2 2 Line Operating Plan

Table G.2-2. Future Baseline (CBTC) Operating Plan – 2 Line – 7th Avenue Express – Flatbush

Wakefield - 241 Street	Nereid Avenue	E 180 Street	96 Street 1 2 3	Chambers Street 1 2 3	Franklin Avenue	Flatbush Avenue - Brooklyn College	New Lots Avenue	New Lots Avenue	Flatbush Avenue - Brooklyn College	Franklin Avenue	Chambers Street 1 2 3	96 Street 1 2 3	E 180 Street	Nereid Avenue	Wakefield - 241 Street
							-	-	0:00:00	0:11:30	0:29:00	0:51:00	1:15:00	1:27:30	1:29:30
							-	-	0:13:00	0:24:30	0:42:00	1:04:00	1:28:00	1:40:30	1:42:30
							-	-	0:24:00	0:35:30	0:53:00	1:15:00	1:39:00	1:51:30	1:53:30
							-	-	0:36:00	0:47:30	1:05:00	1:27:00	1:51:00	2:03:30	2:05:30
							-	-	0:48:00	0:59:30	1:17:00	1:39:00	2:03:00	2:15:30	2:17:30
							-	-	1:00:00	1:11:30	1:29:00	1:51:00	2:15:00	2:27:30	2:29:30
							-	-	1:18:00	1:29:30	1:47:00	2:09:00	2:33:00	2:45:30	2:47:30
							-	-	1:37:00	1:48:30	2:06:00	2:28:00	2:52:00	3:04:30	3:06:30
0:01:00	0:02:00	0:15:30	0:39:30	1:02:30	1:20:00	1:31:00	-	-	1:55:00	2:06:30	2:24:00	2:46:00	3:10:00	3:22:30	3:24:30
0:25:00	0:26:00	0:39:30	1:03:30	1:26:30	1:44:00	1:55:00	-	-	2:19:00	2:30:30	2:48:00	3:10:00	3:34:00	3:46:30	3:48:30
0:43:00	0:44:00	0:57:30	1:21:30	1:44:30	2:02:00	2:13:00	-	-	2:37:00	2:48:30	3:06:00	3:28:00	3:52:00	4:04:30	4:06:30
1:01:00	1:02:00	1:15:30	1:39:30	2:02:30	2:20:00	2:31:00	-	-	2:55:00	3:06:30	3:24:00	3:46:00	4:10:00	4:22:30	4:24:30
1:19:00	1:20:00	1:33:30	1:57:30	2:20:30	2:38:00	2:49:00	-	-	3:19:00	3:30:30	3:48:00	4:10:00	4:34:00	4:46:30	4:48:30
1:43:00	1:44:00	1:57:30	2:21:30	2:44:30	3:02:00	3:13:00	-	-	3:37:00	3:48:30	4:06:00	4:28:00	4:52:00	5:04:30	5:06:30
2:01:00	2:02:00	2:15:30	2:39:30	3:02:30	3:20:00	3:31:00	-	-	3:55:00	4:06:30	4:24:00	4:46:00	5:10:00	5:22:30	5:24:30
2:19:00	2:20:00	2:33:30	2:57:30	3:20:30	3:38:00	3:49:00	-	-	4:19:00	4:30:30	4:48:00	5:10:00	5:34:00	5:46:30	5:48:30
2:43:00	2:44:00	2:57:30	3:21:30	3:44:30	4:02:00	4:13:00	-	-	4:36:00	4:47:30	5:05:00	5:27:00	5:51:00	6:03:30	6:05:30
3:01:00	3:02:00	3:15:30	3:39:30	4:02:30	4:20:00	4:31:00	-	-	4:55:00	5:06:30	5:24:00	5:46:00	6:10:00	6:22:30	6:24:30
3:13:00	3:14:00	3:27:30	3:51:30	4:14:30	4:32:00	4:43:00	-	-	5:07:00	5:18:30	5:36:00	5:58:00	6:22:00	6:34:30	6:36:30
3:28:00	3:29:00	3:42:30	4:06:30	4:29:30	4:47:00	4:58:00	-	-	5:19:00	5:30:30	5:48:00	6:01:30	6:25:30	6:38:00	6:40:00
3:49:00	3:50:00	4:03:30	4:27:30	4:50:30	5:08:00	5:19:00	-	-	5:31:00	5:42:30	6:00:00	6:13:30	6:37:30	6:50:00	6:52:00
4:08:00	4:09:00	4:22:30	4:46:30	5:09:30	5:27:00	5:38:00	-	-	5:42:00	5:53:30	6:11:00	6:24:30	6:48:30	7:01:00	7:03:00
4:20:00	4:21:00	4:34:30	4:58:30	5:21:30	5:39:00	5:50:00	-	-	5:54:00	6:05:30	6:23:00	6:36:30	7:00:30	7:13:00	7:15:00
4:32:00	4:33:00	4:46:30	5:10:30	5:33:30	5:51:00	6:02:00	-	-	6:05:30	6:17:30	6:35:30	6:49:30	7:14:30	7:27:00	7:29:00
4:57:00	4:58:00	5:12:00	5:37:00	5:50:00	6:07:30	6:19:00	-	-	6:23:30	6:35:30	6:53:30	7:07:30	7:32:30	7:45:00	7:47:00
5:09:00	5:10:00	5:24:00	5:49:00	6:02:00	6:19:30	6:31:00	-	-	6:35:30	6:47:30	7:05:30	7:19:30	7:44:30	7:57:00	7:59:00
5:21:00	5:22:00	5:36:00	6:01:00	6:14:00	6:31:30	6:43:00	-	-	6:47:30	6:59:30	7:17:30	7:31:30	7:56:30	8:09:00	8:11:00
-	5:28:00	5:42:00	6:07:00	6:20:00	6:37:30	6:49:00	-	-	6:53:30	7:05:30	7:23:30	7:37:30	8:02:30	8:15:00	8:17:00
5:33:00	5:34:00	5:48:00	6:13:00	6:26:00	6:43:30	6:55:00	-	-	6:58:00	7:10:00	7:29:00	7:43:30	8:09:00	8:21:30	8:23:30
5:45:00	5:46:00	6:00:00	6:25:00	6:38:00	6:55:30	7:07:00	-	-	7:10:00	7:22:00	7:41:00	7:55:30	8:21:00	8:33:30	8:35:30
-	5:52:00	6:06:00	6:31:00	6:44:00	7:01:30	7:13:00	-	-	7:16:00	7:28:00	7:47:00	8:01:30	8:27:00	8:39:30	8:41:30
5:54:30	5:56:00	6:10:00	6:35:30	6:48:30	7:07:00	7:18:30	-	-	7:22:00	7:34:00	7:53:00	8:07:30	8:33:00	8:45:30	8:47:30
-	6:02:00	6:16:00	6:41:30	6:54:30	7:13:00	7:24:30	-	-	7:28:00	7:40:00	7:59:00	8:13:30	8:39:00	8:51:30	8:53:30
6:05:00	6:06:30	6:20:30	6:46:00	6:59:00	7:17:30	7:29:00	-	-	7:34:00	7:46:00	8:05:00	8:19:30	8:45:00	8:57:30	8:59:30

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-2. Future Baseline (CBTC) Operating Plan – 2 Line – 7th Avenue Express – Flatbush

Wakefield - 241 Street	Nereid Avenue	E 180 Street	96 Street 1 2 3	Chambers Street 1 2 3	Franklin Avenue	Flatbush Avenue - Brooklyn College	New Lots Avenue	New Lots Avenue	Flatbush Avenue - Brooklyn College	Franklin Avenue	Chambers Street 1 2 3	96 Street 1 2 3	E 180 Street	Nereid Avenue	Wakefield - 241 Street
-	6:12:00	6:26:00	6:51:30	7:04:30	7:23:00	7:34:30	-	-	7:38:00	7:50:00	8:09:00	8:23:30	8:49:00	9:01:30	9:03:30
6:12:30	6:14:00	6:28:00	6:53:30	7:06:30	7:25:00	7:36:30	-	-	7:40:00	7:52:00	8:11:00	8:25:30	8:51:00	9:03:30	9:05:30
6:18:30	6:20:00	6:34:00	6:59:30	7:12:30	7:31:00	7:42:30	-	-	7:46:00	7:58:00	8:17:00	8:31:30	8:57:00	9:09:30	9:11:30
-	6:26:00	6:40:00	7:05:30	7:18:30	7:37:00	7:48:30	-	-	7:52:00	8:04:00	8:23:00	8:37:30	9:03:00	9:15:30	9:17:30
6:28:30	6:30:00	6:44:00	7:09:30	7:22:30	7:41:00	7:52:30	-	-	7:56:00	8:08:00	8:27:00	8:41:30	9:07:00	9:19:30	-
-	6:32:00	6:46:00	7:11:30	7:24:30	7:43:00	7:54:30	-	-	7:58:00	8:10:00	8:29:00	8:43:30	9:09:00	9:21:30	9:23:30
6:36:30	6:38:00	6:52:00	7:17:30	7:30:30	7:49:00	8:00:30	-	-	8:04:00	8:16:00	8:35:00	8:49:30	9:15:00	9:27:30	9:29:30
6:42:30	6:44:00	6:58:00	7:23:30	7:36:30	7:55:00	8:06:30	-	-	8:10:00	8:22:00	8:41:00	8:55:30	9:21:00	9:33:30	9:35:30
6:46:30	6:48:00	7:02:00	7:27:30	7:40:30	7:59:00	8:10:30	-	-	8:14:00	8:26:00	8:45:00	8:59:30	9:25:00	9:37:30	9:39:30
-	6:50:00	7:04:00	7:29:30	7:42:30	8:01:00	8:12:30	-	-	8:16:00	8:28:00	8:47:00	9:01:30	9:27:00	9:39:30	9:41:30
6:54:30	6:56:00	7:10:00	7:35:30	7:48:30	8:07:00	8:18:30	-	-	8:22:00	8:34:00	8:53:00	9:07:30	9:33:00	9:45:30	9:47:30
7:00:30	7:02:00	7:16:00	7:41:30	7:54:30	8:13:00	8:24:30	-	-	8:28:00	8:40:00	8:59:00	9:13:30	9:39:00	9:51:30	9:53:30
-	7:08:00	7:22:00	7:47:30	8:00:30	8:19:00	8:30:30	-	-	8:34:00	8:46:00	9:05:00	9:19:30	9:45:00	9:57:30	9:59:30
7:10:30	7:12:00	7:26:00	7:51:30	8:04:30	8:23:00	8:34:30	-	-	8:38:00	8:50:00	9:09:00	9:23:30	9:49:00	10:01:30	-
7:12:30	7:14:00	7:28:00	7:53:30	8:06:30	8:25:00	8:36:30	-	-	8:40:00	8:52:00	9:11:00	9:25:30	9:51:00	10:03:30	10:05:30
-	7:20:00	7:34:00	7:59:30	8:12:30	8:31:00	8:42:30	-	-	8:46:00	8:58:00	9:17:00	9:31:30	9:57:00	10:09:30	10:11:30
7:24:30	7:26:00	7:40:00	8:05:30	8:18:30	8:37:00	8:48:30	-	-	8:52:00	9:04:00	9:23:00	9:37:30	10:03:00	10:15:30	10:17:30
-	7:30:00	7:44:00	8:09:30	8:22:30	8:41:00	8:52:30	-	-	8:56:00	9:08:00	9:27:00	9:41:30	10:07:00	10:19:30	-
7:30:30	7:32:00	7:46:00	8:11:30	8:24:30	8:43:00	8:54:30	-	-	8:58:00	9:10:00	9:29:00	9:43:30	10:09:00	10:21:30	10:23:30
7:36:30	7:38:00	7:52:00	8:17:30	8:30:30	8:49:00	9:00:30	-	-	9:05:00	9:17:00	9:35:00	9:49:00	10:14:00	10:26:30	10:28:30
-	7:44:00	7:58:00	8:23:30	8:36:30	8:55:00	9:06:30	-	-	9:10:30	9:22:30	9:40:30	9:54:30	10:19:30	10:32:00	10:34:00
7:46:30	7:48:00	8:02:00	8:27:30	8:40:30	8:59:00	9:10:30	-	-	9:14:00	9:26:00	-	-	-	-	-
-	7:50:00	8:04:00	8:29:30	8:42:30	9:01:00	9:12:30	-	-	9:16:00	9:28:00	9:46:00	10:00:00	10:25:00	10:37:30	-
7:57:00	7:58:00	8:12:00	8:37:00	8:50:00	9:07:30	9:19:00	-	-	9:22:00	9:34:00	9:52:00	10:06:00	10:31:00	10:43:30	10:45:30
8:03:00	8:04:00	8:18:00	8:43:00	8:56:00	9:13:30	9:25:00	-	-	9:28:00	9:40:00	9:58:00	10:12:00	10:37:00	10:49:30	10:51:30
8:09:00	8:10:00	8:24:00	8:49:00	9:02:00	9:19:30	9:31:00	-	-	9:34:00	9:46:00	10:04:00	10:18:00	10:43:00	10:55:30	10:57:30
-	8:14:00	8:28:00	8:53:00	9:06:00	9:23:30	9:35:00	-	-	9:38:00	9:50:00	-	-	-	-	-
8:15:00	8:16:00	8:30:00	8:55:00	9:08:00	9:25:30	9:37:00	-	-	9:40:00	9:52:00	10:10:00	10:24:00	10:49:00	11:01:30	11:03:30
8:21:00	8:22:00	8:36:00	9:01:00	9:14:00	9:31:30	9:43:00	-	-	9:46:00	9:58:00	10:16:00	10:30:00	10:55:00	11:07:30	11:09:30
8:27:00	8:28:00	8:42:00	9:07:00	9:20:00	9:37:30	9:49:00	-	-	9:52:00	10:04:00	10:22:00	10:36:00	11:01:00	11:13:30	11:15:30
8:33:00	8:34:00	8:48:00	9:13:00	9:26:00	9:43:30	9:55:00	-	-	9:58:00	10:09:30	10:27:00	10:40:30	11:04:30	11:17:00	11:19:00
8:39:00	8:40:00	8:54:00	9:19:00	9:32:00	9:49:30	10:01:00	-	-	10:04:00	10:15:30	10:33:00	10:46:30	11:10:30	11:23:00	11:25:00
8:45:00	8:46:00	9:00:00	9:25:00	9:38:00	9:55:30	-	9:58:30	-	-	-	-	-	-	-	-
8:51:00	8:52:00	9:06:00	9:31:00	9:44:00	10:01:30	10:13:00	-	-	10:16:00	10:27:30	10:45:00	10:58:30	11:22:30	11:35:00	11:37:00
8:59:00	9:00:00	9:13:30	9:37:30	9:50:30	10:08:00	10:19:00	-	-	10:22:00	10:33:30	10:51:00	11:04:30	11:28:30	11:41:00	11:43:00
9:05:00	9:06:00	9:19:30	9:43:30	9:56:30	10:14:00	10:25:00	-	-	10:28:00	10:39:30	10:57:00	11:10:30	11:34:30	11:47:00	11:49:00

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-2. Future Baseline (CBTC) Operating Plan – 2 Line – 7th Avenue Express – Flatbush

Wakefield - 241 Street	Nereid Avenue	E 180 Street	96 Street 1 2 3	Chambers Street 1 2 3	Franklin Avenue	Flatbush Avenue - Brooklyn College	New Lots Avenue	New Lots Avenue	Flatbush Avenue - Brooklyn College	Franklin Avenue	Chambers Street 1 2 3	96 Street 1 2 3	E 180 Street	Nereid Avenue	Wakefield - 241 Street
9:11:00	9:12:00	9:25:30	9:49:30	10:02:30	10:20:00	10:31:00	-	-	10:34:00	10:45:30	11:03:00	11:16:30	11:40:30	11:53:00	11:55:00
9:17:00	9:18:00	9:31:30	9:55:30	10:08:30	10:26:00	10:37:00	-	-	10:40:00	10:51:30	11:09:00	11:22:30	11:46:30	11:59:00	12:01:00
9:23:00	9:24:00	9:37:30	10:01:30	10:14:30	10:32:00	-	10:34:30								
9:29:00	9:30:00	9:43:30	10:07:30	10:20:30	10:38:00	10:49:00	-	-	10:52:00	11:03:30	11:21:00	11:34:30	11:58:30	12:11:00	12:13:00
9:33:00	9:34:00	9:47:30	10:11:30	10:24:30	10:42:00	10:53:00	-	-	10:56:00	11:07:30	11:25:00	11:38:30	12:02:30	12:15:00	12:17:00
9:43:00	9:44:00	9:57:30	10:21:30	10:34:30	10:52:00	11:03:00	-	-	11:06:00	11:17:30	11:35:00	11:48:30	12:12:30	12:25:00	12:27:00
9:52:00	9:53:00	10:06:30	10:30:30	10:43:30	11:01:00	11:12:00	-	-	11:15:00	11:26:30	11:44:00	11:57:30	12:21:30	12:34:00	12:36:00
9:59:00	10:00:00	10:13:30	10:37:30	10:50:30	11:08:00	11:19:00	-	-	11:22:00	11:33:30	11:51:00	12:04:30	12:28:30	12:41:00	12:43:00
10:05:00	10:06:00	10:19:30	10:43:30	10:56:30	11:14:00	11:25:00	-	-	11:28:00	11:39:30	11:57:00	12:10:30	12:34:30	12:47:00	12:49:00
10:15:00	10:16:00	10:29:30	10:53:30	11:06:30	11:24:00	11:35:00	-	-	11:38:00	11:49:30	12:07:00	12:20:30	12:44:30	12:57:00	12:59:00
10:23:00	10:24:00	10:37:30	11:01:30	11:14:30	11:32:00	11:43:00	-	-	11:46:00	11:57:30	12:15:00	12:28:30	12:52:30	13:05:00	13:07:00
10:29:00	10:30:00	10:43:30	11:07:30	11:20:30	11:38:00	11:49:00	-	-	11:52:00	12:03:30	12:21:00	12:34:30	12:58:30	13:11:00	13:13:00
10:35:00	10:36:00	10:49:30	11:13:30	11:26:30	11:44:00	11:55:00	-	-	11:58:00	12:09:30	12:27:00	12:40:30	13:04:30	13:17:00	13:19:00
10:47:00	10:48:00	11:01:30	11:25:30	11:38:30	11:56:00	12:07:00	-	-	12:10:00	12:21:30	12:39:00	12:52:30	13:16:30	13:29:00	13:31:00
10:53:00	10:54:00	11:07:30	11:31:30	11:44:30	12:02:00	12:13:00	-	-	12:16:00	12:27:30	12:45:00	12:58:30	13:22:30	13:35:00	13:37:00
10:59:00	11:00:00	11:13:30	11:37:30	11:50:30	12:08:00	12:19:00	-	-	12:22:00	12:33:30	12:51:00	13:04:30	13:28:30	13:41:00	13:43:00
11:11:00	11:12:00	11:25:30	11:49:30	12:02:30	12:20:00	12:31:00	-	-	12:34:00	12:45:30	13:03:00	13:16:30	13:40:30	13:53:00	13:55:00
11:17:00	11:18:00	11:31:30	11:55:30	12:08:30	12:26:00	12:37:00	-	-	12:40:00	12:51:30	13:09:00	13:22:30	13:46:30	13:59:00	14:01:00
11:23:00	11:24:00	11:37:30	12:01:30	12:14:30	12:32:00	12:43:00	-	-	12:46:00	12:57:30	13:15:00	13:28:30	13:52:30	14:05:00	14:07:00
11:33:00	11:34:00	11:47:30	12:11:30	12:24:30	12:42:00	12:53:00	-	-	12:56:00	13:07:30	13:25:00	13:38:30	14:02:30	14:15:00	14:17:00
11:41:00	11:42:00	11:55:30	12:19:30	12:32:30	12:50:00	13:01:00	-	-	13:04:00	13:15:30	13:33:00	13:46:30	14:10:30	14:23:00	14:25:00
11:51:00	11:52:00	12:05:30	12:29:30	12:42:30	13:00:00	13:11:00	-	-	13:14:00	13:25:30	13:43:00	13:56:30	14:20:30	14:33:00	14:35:00
11:59:00	12:00:00	12:13:30	12:37:30	12:50:30	13:08:00	13:19:00	-	-	13:22:00	13:33:30	13:51:00	14:04:30	14:28:30	14:41:00	14:43:00
12:05:00	12:06:00	12:19:30	12:43:30	12:56:30	13:14:00	13:25:00	-	-	13:28:00	13:39:30	13:57:00	14:10:30	14:34:30	14:47:00	14:49:00
12:15:00	12:16:00	12:29:30	12:53:30	13:06:30	13:24:00	13:35:00	-	-	13:38:00	13:49:30	14:07:00	14:20:30	14:44:30	14:57:00	14:59:00
12:23:00	12:24:00	12:37:30	13:01:30	13:14:30	13:32:00	13:43:00	-	-	13:46:00	13:57:30	14:15:00	14:28:30	14:52:30	15:05:00	15:07:00
12:29:00	12:30:00	12:43:30	13:07:30	13:20:30	13:38:00	13:49:00	-	-	13:52:00	14:03:30	14:21:00	14:34:30	14:58:30	15:11:00	15:13:00
12:35:00	12:36:00	12:49:30	13:13:30	13:26:30	13:44:00	13:55:00	-	-	13:58:00	14:09:30	14:27:00	14:40:30	15:04:30	15:17:00	15:19:00
12:47:00	12:48:00	13:01:30	13:25:30	13:38:30	13:56:00	14:07:00	-	-	14:10:00	14:21:30	14:39:00	14:52:30	15:16:30	15:29:00	15:31:00
12:53:00	12:54:00	13:07:30	13:31:30	13:44:30	14:02:00	14:13:00	-	-	14:16:00	14:27:30	14:45:00	14:58:30	15:22:30	15:35:00	15:37:00
12:59:00	13:00:00	13:13:30	13:37:30	13:50:30	14:08:00	14:19:00	-	-	14:22:00	14:33:30	14:51:00	15:04:30	15:28:30	15:41:00	15:43:00
13:11:00	13:12:00	13:25:30	13:49:30	14:02:30	14:20:00	14:31:00	-	-	14:34:00	14:45:30	15:03:00	15:16:30	15:40:30	15:53:00	15:55:00
13:17:00	13:18:00	13:31:30	13:55:30	14:08:30	14:26:00	14:37:00	-	-	14:40:00	14:51:30	15:09:00	15:22:30	15:46:30	15:59:00	16:01:00
13:23:00	13:24:00	13:37:30	14:01:30	14:14:30	14:32:00	14:43:00	-	-	14:46:00	14:57:30	15:15:00	15:28:30	15:52:30	16:05:00	16:07:00
13:33:00	13:34:00	13:47:30	14:11:30	14:24:30	14:42:00	14:53:00	-	-	14:56:00	15:07:30	15:25:00	15:38:30	16:02:30	16:15:00	16:17:00
13:41:00	13:42:00	13:55:30	14:19:30	14:32:30	14:50:00	15:01:00	-	-	15:04:00	15:16:00	15:34:00	15:48:00	16:13:00	16:25:30	16:27:30

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-2. Future Baseline (CBTC) Operating Plan – 2 Line – 7th Avenue Express – Flatbush

Wakefield - 241 Street	Nereid Avenue	E 180 Street	96 Street 1 2 3	Chambers Street 1 2 3	Franklin Avenue	Flatbush Avenue - Brooklyn College	New Lots Avenue	New Lots Avenue	Flatbush Avenue - Brooklyn College	Franklin Avenue	Chambers Street 1 2 3	96 Street 1 2 3	E 180 Street	Nereid Avenue	Wakefield - 241 Street
13:51:00	13:52:00	14:05:30	14:29:30	14:42:30	15:00:00	15:11:00	-	-	15:14:00	15:26:00	15:44:00	15:58:00	16:23:00	16:35:30	16:37:30
13:57:00	13:58:00	14:12:00	14:37:00	14:50:00	15:07:30	15:19:00	-	-	15:22:00	15:34:00	15:52:00	16:06:00	16:31:00	16:43:30	16:45:30
14:03:00	14:04:00	14:18:00	14:43:00	14:56:00	15:13:30	15:25:00	-	-	15:28:00	15:40:00	15:58:00	16:12:00	16:37:00	16:49:30	16:51:30
14:09:00	14:10:00	14:24:00	14:49:00	15:02:00	15:19:30	15:31:00	-	-	15:34:00	15:46:00	16:04:00	16:18:00	16:43:00	16:55:30	16:57:30
								15:41:00	-	15:56:00	16:14:00	16:28:00	16:53:00	17:05:30	17:07:30
14:21:00	14:22:00	14:36:00	15:01:00	15:14:00	15:31:30	15:43:00	-	-	15:46:00	15:58:00	16:16:00	16:30:00	16:55:00	17:07:30	17:09:30
								15:55:00	-	16:10:00	16:28:00	16:42:00	17:07:00	17:19:30	17:21:30
14:31:00	14:32:00	14:46:00	15:11:00	15:24:00	15:41:30	15:53:00	-	-	15:56:00	16:08:00	16:26:00	16:40:00	17:05:00	17:17:30	17:19:30
-	-	-	-	-	15:43:30	15:55:00	-	-	16:01:00	16:13:00	16:32:00	16:46:30	17:12:00	17:24:30	17:26:30
14:39:00	14:40:00	14:54:00	15:19:00	15:32:00	15:49:30	16:01:00	-	-	16:08:00	16:20:00	16:39:00	16:53:30	17:19:00	17:31:30	17:33:30
14:49:00	14:50:00	15:04:00	15:29:00	15:42:00	15:59:30	16:11:00	-	-	16:14:00	16:26:00	16:45:00	16:59:30	17:25:00	17:37:30	17:39:30
-	-	-	-	-	15:59:30	16:11:00	-	-	16:16:00	16:28:00	16:47:00	17:01:30	17:27:00	17:39:30	17:41:30
14:54:30	14:56:00	15:10:00	15:35:30	15:48:30	16:07:00	16:18:30	-	-	16:22:00	16:34:00	16:53:00	17:07:30	17:33:00	17:45:30	17:47:30
15:00:30	15:02:00	15:16:00	15:41:30	15:54:30	16:13:00	16:24:30	-	-	16:28:00	16:40:00	16:59:00	17:13:30	17:39:00	17:51:30	17:53:30
15:06:30	15:08:00	15:22:00	15:47:30	16:00:30	16:19:00	16:30:30	-	-	16:34:00	16:46:00	17:05:00	17:19:30	17:45:00	17:57:30	17:59:30
15:10:30	15:12:00	15:26:00	15:51:30	16:04:30	16:23:00	16:34:30	-	-	16:38:00	16:50:00	17:09:00	17:23:30	17:49:00	18:01:30	18:03:30
15:12:30	15:14:00	15:28:00	15:53:30	16:06:30	16:25:00	16:36:30	-	-	16:40:00	16:52:00	17:11:00	17:25:30	17:51:00	18:03:30	-
15:18:30	15:20:00	15:34:00	15:59:30	16:12:30	16:31:00	16:42:30	-	-	16:46:00	16:58:00	17:17:00	17:31:30	17:57:00	18:09:30	18:11:30
15:24:30	15:26:00	15:40:00	16:05:30	16:18:30	16:37:00	16:48:30	-	-	16:52:00	17:04:00	17:23:00	17:37:30	18:03:00	18:15:30	18:17:30
15:28:30	15:30:00	15:44:00	16:09:30	16:22:30	16:41:00	16:52:30	-	-	16:56:00	17:08:00	17:27:00	17:41:30	18:07:00	18:19:30	18:21:30
-	15:32:00	15:46:00	16:11:30	16:24:30	16:43:00	16:54:30	-	-	16:58:00	17:10:00	17:29:00	17:43:30	18:09:00	18:21:30	18:23:30
15:36:30	15:38:00	15:52:00	16:17:30	16:30:30	16:49:00	17:00:30	-	-	17:04:00	17:16:00	17:35:00	17:49:30	18:15:00	18:27:30	18:29:30
15:42:30	15:44:00	15:58:00	16:23:30	16:36:30	16:55:00	17:06:30	-	-	17:10:00	17:22:00	17:41:00	17:55:30	18:21:00	18:33:30	18:35:30
15:46:30	15:48:00	16:02:00	16:27:30	16:40:30	16:59:00	17:10:30	-	-	17:14:00	17:26:00	17:45:00	17:59:30	18:25:00	18:37:30	18:39:30
15:48:30	15:50:00	16:04:00	16:29:30	16:42:30	17:01:00	17:12:30	-	-	17:16:00	17:28:00	17:47:00	18:01:30	18:27:00	18:39:30	18:41:30
-	15:56:00	16:10:00	16:35:30	16:48:30	17:07:00	17:18:30	-	-	17:22:00	17:34:00	17:53:00	18:07:30	18:33:00	18:45:30	18:47:30
16:00:30	16:02:00	16:16:00	16:41:30	16:54:30	17:13:00	17:24:30	-	-	17:28:00	17:40:00	17:59:00	18:13:30	18:39:00	18:51:30	18:53:30
16:06:30	16:08:00	16:22:00	16:47:30	17:00:30	17:19:00	17:30:30	-	-	17:34:00	17:46:00	18:05:00	18:19:30	18:45:00	18:57:30	18:59:30
16:10:30	16:12:00	16:26:00	16:51:30	17:04:30	17:23:00	17:34:30	-	-	17:38:00	17:50:00	18:09:00	18:23:30	18:49:00	19:01:30	19:03:30
16:12:30	16:14:00	16:28:00	16:53:30	17:06:30	17:25:00	17:36:30	-	-	17:40:00	17:52:00	18:11:00	18:25:30	18:51:00	19:03:30	19:05:30
16:18:30	16:20:00	16:34:00	16:59:30	17:12:30	17:31:00	17:42:30	-	-	17:46:00	17:58:00	18:17:00	18:31:30	18:57:00	19:09:30	19:11:30
16:24:30	16:26:00	16:40:00	17:05:30	17:18:30	17:37:00	17:48:30	-	-	17:52:00	18:04:00	18:23:00	18:37:30	19:03:00	19:15:30	19:17:30
-	16:30:00	16:44:00	17:09:30	17:22:30	17:41:00	17:52:30	-	-	17:56:00	18:08:00	18:27:00	18:41:30	19:07:00	19:19:30	19:21:30
16:30:30	16:32:00	16:46:00	17:11:30	17:24:30	17:43:00	17:54:30	-	-	17:58:00	18:10:00	18:29:00	18:43:30	19:09:00	19:21:30	-
16:36:30	16:38:00	16:52:00	17:17:30	17:30:30	17:49:00	18:00:30	-	-	18:04:00	18:16:00	18:34:00	18:48:00	19:13:00	19:25:30	19:27:30
16:42:30	16:44:00	16:58:00	17:23:30	17:36:30	17:55:00	18:06:30	-	-	18:10:00	18:22:00	18:40:00	18:54:00	19:19:00	19:31:30	19:33:30

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-2. Future Baseline (CBTC) Operating Plan – 2 Line – 7th Avenue Express – Flatbush

Wakefield - 241 Street	Nereid Avenue	E 180 Street	96 Street 1 2 3	Chambers Street 1 2 3	Franklin Avenue	Flatbush Avenue - Brooklyn College	New Lots Avenue	New Lots Avenue	Flatbush Avenue - Brooklyn College	Franklin Avenue	Chambers Street 1 2 3	96 Street 1 2 3	E 180 Street	Nereid Avenue	Wakefield - 241 Street
16:46:30	16:48:00	17:02:00	17:27:30	17:40:30	17:59:00	18:10:30	-	-	18:14:00	18:26:00	18:44:00	18:58:00	19:23:00	19:35:30	19:37:30
16:57:00	16:58:00	17:12:00	17:37:00	17:50:00	18:07:30	18:19:00	-	-	18:22:00	18:34:00	18:52:00	19:06:00	19:31:00	19:43:30	19:45:30
17:03:00	17:04:00	17:18:00	17:43:00	17:56:00	18:13:30	18:25:00	-	-	18:28:00	18:40:00	18:58:00	19:12:00	19:37:00	19:49:30	19:51:30
17:09:00	17:10:00	17:24:00	17:49:00	18:02:00	18:19:30	18:31:00	-	-	18:34:00	18:46:00	19:04:00	19:18:00	19:43:00	19:55:30	19:57:30
17:13:00	17:14:00	17:28:00	17:53:00	18:06:00	18:23:30	18:35:00	-	-	18:38:00	18:50:00	19:08:00	19:22:00	19:47:00	19:59:30	20:01:30
17:21:00	17:22:00	17:36:00	18:01:00	18:14:00	18:31:30	18:43:00	-	-	18:46:00	18:58:00	19:16:00	19:30:00	19:55:00	20:07:30	20:09:30
17:27:00	17:28:00	17:42:00	18:07:00	18:20:00	18:37:30	18:49:00	-	-	18:52:00	19:04:00	19:22:00	19:36:00	20:01:00	20:13:30	20:15:30
17:33:00	17:34:00	17:48:00	18:13:00	18:26:00	18:43:30	18:55:00	-	-	18:58:00	19:10:00	19:28:00	19:42:00	20:07:00	20:19:30	20:21:30
17:39:00	17:40:00	17:54:00	18:19:00	18:32:00	18:49:30	19:01:00	-	-	19:04:00	19:15:30	19:33:00	19:46:30	20:10:30	20:23:00	20:25:00
17:49:00	17:50:00	18:04:00	18:29:00	18:42:00	18:59:30	19:11:00	-	-	19:14:00	19:25:30	19:43:00	19:56:30	20:20:30	20:33:00	20:35:00
17:59:00	18:00:00	18:13:30	18:37:30	18:50:30	19:08:00	19:19:00	-	-	19:22:00	19:33:30	19:51:00	20:04:30	20:28:30	20:41:00	20:43:00
18:05:00	18:06:00	18:19:30	18:43:30	18:56:30	19:14:00	19:25:00	-	-	19:28:00	19:39:30	19:57:00	20:10:30	20:34:30	20:47:00	20:49:00
18:11:00	18:12:00	18:25:30	18:49:30	19:02:30	19:20:00	19:31:00	-	-	19:34:00	19:45:30	20:03:00	20:16:30	20:40:30	20:53:00	20:55:00
18:17:00	18:18:00	18:31:30	18:55:30	19:08:30	19:26:00	19:37:00	-	-	19:40:00	19:51:30	20:09:00	20:22:30	20:46:30	20:59:00	21:01:00
18:23:00	18:24:00	18:37:30	19:01:30	19:14:30	19:32:00	19:43:00	-	-	19:46:00	19:57:30	20:15:00	20:28:30	20:52:30	21:05:00	21:07:00
18:29:00	18:30:00	18:43:30	19:07:30	19:20:30	19:38:00	19:49:00	-	-	19:52:00	20:03:30	20:21:00	20:34:30	20:58:30	21:11:00	21:13:00
18:35:00	18:36:00	18:49:30	19:13:30	19:26:30	19:44:00	19:55:00	-	-	19:58:00	20:09:30	20:27:00	20:40:30	21:04:30	21:17:00	21:19:00
18:41:00	18:42:00	18:55:30	19:19:30	19:32:30	19:50:00	20:01:00	-	-	20:04:00	20:15:30	20:33:00	20:46:30	21:10:30	21:23:00	21:25:00
18:51:00	18:52:00	19:05:30	19:29:30	19:42:30	20:00:00	20:11:00	-	-	20:14:00	20:25:30	20:43:00	20:56:30	21:20:30	21:33:00	21:35:00
18:59:00	19:00:00	19:13:30	19:37:30	19:50:30	20:08:00	20:19:00	-	-	20:22:00	20:33:30	20:51:00	21:04:30	21:28:30	21:41:00	21:43:00
19:05:00	19:06:00	19:19:30	19:43:30	19:56:30	20:14:00	20:25:00	-	-	20:28:00	20:39:30	20:57:00	21:10:30	21:34:30	21:47:00	21:49:00
19:11:00	19:12:00	19:25:30	19:49:30	20:02:30	20:20:00	20:31:00	-	-	20:34:00	20:45:30	21:03:00	21:16:30	21:40:30	21:53:00	-
19:17:00	19:18:00	19:31:30	19:55:30	20:08:30	20:26:00	20:37:00	-	-	20:40:00	20:51:30	21:09:00	21:22:30	21:46:30	21:59:00	22:01:00
19:23:00	19:24:00	19:37:30	20:01:30	20:14:30	20:32:00	20:43:00	-	-	20:46:00	20:57:30	21:15:00	21:28:30	21:52:30	22:05:00	22:07:00
19:33:00	19:34:00	19:47:30	20:11:30	20:24:30	20:42:00	20:53:00	-	-	20:56:00	21:07:30	21:25:00	21:38:30	22:02:30	22:15:00	22:17:00
19:41:00	19:42:00	19:55:30	20:19:30	20:32:30	20:50:00	21:01:00	-	-	21:04:00	21:15:30	21:33:00	21:46:30	22:10:30	22:23:00	22:25:00
19:47:00	19:48:00	20:01:30	20:25:30	20:38:30	20:56:00	21:07:00	-	-	21:10:00	21:21:30	21:39:00	21:52:30	22:16:30	22:29:00	-
19:53:00	19:54:00	20:07:30	20:31:30	20:44:30	21:02:00	21:13:00	-	-	21:16:00	21:27:30	21:45:00	21:58:30	22:22:30	22:35:00	22:37:00
19:58:00	19:59:00	20:12:30	20:36:30	20:49:30	21:07:00	21:18:00	-	-	21:21:00	21:32:30	21:50:00	22:03:30	22:27:30	22:40:00	22:42:00
20:05:00	20:06:00	20:19:30	20:43:30	20:56:30	21:14:00	21:25:00	-	-	21:28:00	21:39:30	21:57:00	22:10:30	22:34:30	22:47:00	22:49:00
20:15:00	20:16:00	20:29:30	20:53:30	21:06:30	21:24:00	21:35:00	-	-	21:38:00	21:49:30	22:07:00	22:20:30	22:44:30	22:57:00	22:59:00
20:23:00	20:24:00	20:37:30	21:01:30	21:14:30	21:32:00	21:43:00	-	-	21:46:00	21:57:30	22:15:00	22:28:30	22:52:30	23:05:00	23:07:00
20:35:00	20:36:00	20:49:30	21:13:30	21:26:30	21:44:00	21:55:00	-	-	21:58:00	22:09:30	22:27:00	22:40:30	23:04:30	23:17:00	23:19:00
20:47:00	20:48:00	21:01:30	21:25:30	21:38:30	21:56:00	22:07:00	-	-	22:14:00	22:25:30	22:43:00	22:56:30	23:20:30	23:33:00	23:35:00
20:59:00	21:00:00	21:13:30	21:37:30	21:50:30	22:08:00	22:19:00	-	-	22:26:00	22:37:30	22:55:00	23:08:30	23:32:30	23:45:00	23:47:00
21:11:00	21:12:00	21:25:30	21:49:30	22:02:30	22:20:00	22:31:00	-	-	22:38:00	22:49:30	23:07:00	23:20:30	23:44:30	23:57:00	23:59:00

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-2. Future Baseline (CBTC) Operating Plan – 2 Line – 7th Avenue Express – Flatbush

Wakefield - 241 Street	Nereid Avenue	E 180 Street	96 Street 1 2 3	Chambers Street 1 2 3	Franklin Avenue	Flatbush Avenue - Brooklyn College	New Lots Avenue	New Lots Avenue	Flatbush Avenue - Brooklyn College	Franklin Avenue	Chambers Street 1 2 3	96 Street 1 2 3	E 180 Street	Nereid Avenue	Wakefield - 241 Street
21:17:00	21:18:00	21:31:30	21:55:30	22:08:30	22:26:00	22:37:00	-	-	22:44:00	22:55:30	23:13:00	23:26:30	23:50:30	24:03:00	24:05:00
21:29:00	21:30:00	21:43:30	22:07:30	22:20:30	22:38:00	22:49:00	-	-	22:56:00	23:07:30	23:25:00	23:38:30	24:02:30	24:15:00	24:17:00
21:35:00	21:36:00	21:49:30	22:13:30	22:26:30	22:44:00	22:55:00	-	-	23:04:00	23:15:30	23:33:00	23:46:30	24:10:30	24:23:00	24:25:00
21:48:00	21:49:00	22:02:30	22:26:30	22:39:30	22:57:00	23:08:00	-	-	23:14:00	23:25:30	23:43:00	23:56:30	24:20:30	24:33:00	24:35:00
21:59:00	22:00:00	22:13:30	22:37:30	22:50:30	23:08:00	23:19:00	-	-	23:28:00	23:39:30	23:57:00	24:10:30	24:34:30	24:47:00	24:49:00
22:11:00	22:12:00	22:25:30	22:49:30	23:02:30	23:20:00	23:31:00	-	-	23:42:00	23:53:30	24:11:00	24:33:00	24:57:00	25:09:30	25:11:30
22:29:00	22:30:00	22:43:30	23:07:30	23:20:30	23:38:00	23:49:00	-	-	24:00:00	24:11:30	24:29:00	24:51:00	25:15:00	25:27:30	25:29:30
22:41:00	22:42:00	22:55:30	23:19:30	23:32:30	23:50:00	24:01:00	-	-	24:13:00	24:24:30	24:42:00	25:04:00	25:28:00	25:40:30	25:42:30
22:53:00	22:54:00	23:07:30	23:31:30	23:44:30	24:02:00	24:13:00	-	-	24:24:00	24:35:30	24:53:00	25:15:00	25:39:00	25:51:30	25:53:30
23:05:00	23:06:00	23:19:30	23:43:30	23:56:30	24:14:00	24:25:00	-	-	24:36:00	24:47:30	25:05:00	25:27:00	25:51:00	26:03:30	26:05:30
23:17:00	23:18:00	23:31:30	23:55:30	24:08:30	24:26:00	24:37:00	-	-	24:48:00	24:59:30	25:17:00	25:39:00	26:03:00	26:15:30	26:17:30
23:32:00	23:33:00	23:46:30	24:10:30	24:23:30	24:41:00	24:52:00	-	-	25:00:00	25:11:30	25:29:00	25:51:00	26:15:00	26:27:30	26:29:30
23:49:00	23:50:00	24:03:30	24:27:30	24:40:30	24:58:00	25:09:00	-	-	25:18:00	25:29:30	25:47:00	26:09:00	26:33:00	26:45:30	26:47:30
23:55:00	23:56:00	24:09:30	24:33:30	24:56:30	25:14:00	25:25:00	-	-	25:37:00	25:48:30	26:06:00	26:28:00	26:52:00	27:04:30	27:06:30
24:10:00	24:11:00	24:24:30	24:48:30	25:11:30	25:29:00	25:40:00	-	-	25:55:00	26:06:30	26:24:00	26:46:00	27:10:00	27:22:30	27:24:30
24:25:00	24:26:00	24:39:30	25:03:30	25:26:30	25:44:00	25:55:00	-								
24:43:00	24:44:00	24:57:30	25:21:30	25:44:30	26:02:00	26:13:00	-								
25:01:00	25:02:00	25:15:30	25:39:30	26:02:30	26:20:00	26:31:00	-								
25:19:00	25:20:00	25:33:30	25:57:30	26:20:30	26:38:00	26:49:00	-								
25:43:00	25:44:00	25:57:30	26:21:30	26:44:30	27:02:00	27:13:00	-								

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

G.2.3 ③ Line Operating Plan

Table G.2-3. Future Baseline (CBTC) Operating Plan – ③ Line – 7th Avenue Express – New Lots

148 Street	135 Street	96 Street ① ② ③	Times Sq - 42 Street	Chambers Street ① ② ③	Atlantic Avenue	Crown Heights - Utica Avenue	New Lots Avenue	New Lots Avenue	Crown Heights - Utica Avenue	Atlantic Avenue	Chambers Street ① ② ③	Times Sq - 42 Street	96 Street ① ② ③	135 Street	148 Street
0:10:00	0:13:30	0:21:00	0:27:00	-	-	-	-	-	-	-	-	0:47:00	0:52:30	1:00:30	1:05:00
0:30:00	0:33:30	0:41:00	0:47:00	-	-	-	-	-	-	-	-	1:07:00	1:12:30	1:20:30	1:25:00
0:50:00	0:53:30	1:01:00	1:07:00	-	-	-	-	-	-	-	-	1:27:00	1:32:30	1:40:30	1:45:00
1:10:00	1:13:30	1:21:00	1:27:00	-	-	-	-	-	-	-	-	1:47:00	1:52:30	2:00:30	2:05:00
1:30:00	1:33:30	1:41:00	1:47:00	-	-	-	-	-	-	-	-	2:07:00	2:12:30	2:20:30	2:25:00
1:50:00	1:53:30	2:01:00	2:07:00	-	-	-	-	-	-	-	-	2:27:00	2:32:30	2:40:30	2:45:00
2:10:00	2:13:30	2:21:00	2:27:00	-	-	-	-	-	-	-	-	2:47:00	2:52:30	3:00:30	3:05:00
2:30:00	2:33:30	2:41:00	2:47:00	-	-	-	-	-	-	-	-	3:07:00	3:12:30	3:20:30	3:25:00
2:50:00	2:53:30	3:01:00	3:07:00	-	-	-	-	-	-	-	-	3:27:00	3:32:30	3:40:30	3:45:00
3:10:00	3:13:30	3:21:00	3:27:00	-	-	-	-	-	-	-	-	3:47:00	3:52:30	4:00:30	4:05:00
3:30:00	3:33:30	3:41:00	3:47:00	-	-	-	-	-	-	-	-	4:07:00	4:12:30	4:20:30	4:25:00
3:50:00	3:53:30	4:01:00	4:07:00	-	-	-	-	-	-	-	-	4:27:00	4:32:30	4:40:30	4:45:00
4:10:00	4:13:30	4:21:00	4:27:00	-	-	-	-	-	-	-	-	4:47:00	4:52:30	5:00:30	5:05:00
4:30:00	4:33:30	4:41:00	4:47:00	-	-	-	-	-	-	-	-	5:07:00	5:12:30	5:20:30	5:25:00
4:50:00	4:53:30	5:01:00	5:07:00	-	-	-	-	-	-	-	-	5:27:00	5:32:30	5:40:30	5:45:00
								5:03:00	5:12:30	5:21:30	-	-	-	-	-
								5:15:00	5:24:30	5:33:30	-	-	-	-	-
								5:41:00	5:50:30	5:59:30	6:12:00	6:19:30	6:25:00	6:33:00	6:37:30
								6:05:00	6:14:30	6:23:30	6:36:00	6:43:30	6:49:00	6:57:00	7:01:30
5:11:00	5:14:30	5:22:00	5:28:00	5:35:00	5:47:30	5:58:00	6:07:00	6:17:30	6:27:00	6:37:00	6:49:30	6:57:00	7:02:30	7:10:30	7:15:00
5:18:00	5:21:30	5:29:00	5:35:00	-	-	-	-	-	-	-	-	5:47:00	5:52:30	6:00:30	6:05:00
								6:23:30	6:33:00	6:43:00	6:55:30	7:03:00	7:08:30	7:16:30	7:21:00
5:27:30	5:31:00	5:38:30	5:44:30	5:51:30	6:04:00	6:15:00	6:24:30	6:35:30	6:45:00	6:55:00	7:07:30	7:15:00	7:20:30	7:28:30	7:33:00
5:39:30	5:43:00	5:50:30	5:56:30	-	-	-	-	-	-	-	-	6:07:00	6:12:30	6:20:30	6:25:00
5:44:30	5:48:00	5:55:30	6:01:30	6:08:30	6:21:00	6:32:00	6:41:30	6:47:30	6:57:00	7:07:00	7:19:30	7:27:00	7:32:30	7:40:30	7:45:00
								6:59:30	7:09:00	7:19:00	7:31:30	7:39:00	7:44:30	7:52:30	7:57:00
5:57:30	6:01:00	6:08:30	6:14:30	6:21:30	6:34:00	6:45:00	6:54:30	7:04:00	7:14:30	7:24:30	7:37:00	7:44:30	7:50:00	7:58:00	8:02:30
6:09:30	6:13:00	6:20:30	6:26:30	6:33:30	6:46:00	6:57:00	7:06:30	7:16:00	7:26:30	7:36:30	7:49:00	7:56:30	8:02:00	8:10:00	8:14:30
6:15:30	6:19:00	6:26:30	6:32:30	6:39:30	6:52:00	7:03:00	7:12:30	7:22:00	7:32:30	7:42:30	7:55:00	8:02:30	8:08:00	8:16:00	8:20:30
6:27:00	6:30:30	6:38:00	6:44:00	6:51:00	7:03:30	7:14:30	7:25:00	7:26:00	7:36:30	7:46:30	7:59:00	8:06:30	8:12:00	8:20:00	8:24:30
6:33:00	6:36:30	6:44:00	6:50:00	6:57:00	7:09:30	7:20:30	7:31:00	7:32:00	7:42:30	7:52:30	8:05:00	8:12:30	8:18:00	8:26:00	8:30:30
6:35:00	6:38:30	6:46:00	6:52:00	6:59:00	7:11:30	7:22:30	7:33:00	7:38:00	7:48:30	7:58:30	8:11:00	8:18:30	8:24:00	8:32:00	8:36:30
6:39:00	6:42:30	6:50:00	6:56:00	7:03:00	7:15:30	7:26:30	7:37:00	7:40:00	7:50:30	8:00:30	8:13:00	8:20:30	8:26:00	8:34:00	8:38:30
6:45:00	6:48:30	6:56:00	7:02:00	7:09:00	7:21:30	7:32:30	7:43:00	7:44:00	7:54:30	8:04:30	8:17:00	8:24:30	8:30:00	8:38:00	8:42:30

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-3. Future Baseline (CBTC) Operating Plan – 3 Line – 7th Avenue Express – New Lots

148 Street	135 Street	96 Street 1 2 3	Times Sq - 42 Street	Chambers Street 1 2 3	Atlantic Avenue	Crown Heights - Utica Avenue	New Lots Avenue	New Lots Avenue	Crown Heights - Utica Avenue	Atlantic Avenue	Chambers Street 1 2 3	Times Sq - 42 Street	96 Street 1 2 3	135 Street	148 Street
6:51:00	6:54:30	7:02:00	7:08:00	7:15:00	7:27:30	7:38:30	7:49:00	7:50:00	8:00:30	8:10:30	8:23:00	8:30:30	8:36:00	8:44:00	8:48:30
6:53:00	6:56:30	7:04:00	7:10:00	7:17:00	7:29:30	7:40:30	7:51:00	7:56:00	8:06:30	8:16:30	8:29:00	8:36:30	8:42:00	8:50:00	8:54:30
6:57:00	7:00:30	7:08:00	7:14:00	7:21:00	7:33:30	7:44:30	7:55:00	7:58:00	8:08:30	8:18:30	8:31:00	8:38:30	8:44:00	8:52:00	8:56:30
7:03:00	7:06:30	7:14:00	7:20:00	7:27:00	7:39:30	7:50:30	8:01:00	8:02:00	8:12:30	8:22:30	8:35:00	8:42:30	8:48:00	8:56:00	9:00:30
7:09:00	7:12:30	7:20:00	7:26:00	7:33:00	7:45:30	7:56:30	8:07:00	8:08:00	8:18:30	8:28:30	8:41:00	8:48:30	8:54:00	9:02:00	9:06:30
7:11:00	7:14:30	7:22:00	7:28:00	7:35:00	7:47:30	7:58:30	8:09:00	8:14:00	8:24:30	8:34:30	8:47:00	8:54:30	9:00:00	9:08:00	9:12:30
7:15:00	7:18:30	7:26:00	7:32:00	7:39:00	7:51:30	8:02:30	8:13:00	8:16:00	8:26:30	8:36:30	8:49:00	8:56:30	9:02:00	9:10:00	9:14:30
7:21:00	7:24:30	7:32:00	7:38:00	7:45:00	7:57:30	8:08:30	8:19:00	8:20:00	8:30:30	8:40:30	8:53:00	9:00:30	9:06:00	9:14:00	9:18:30
7:27:00	7:30:30	7:38:00	7:44:00	7:51:00	8:03:30	8:14:30	8:25:00	8:26:00	8:36:30	8:46:30	8:59:00	9:06:30	9:12:00	9:20:00	9:24:30
7:33:00	7:36:30	7:44:00	7:50:00	7:57:00	8:09:30	8:20:30	8:31:00	8:32:00	8:42:30	8:52:30	9:05:00	9:12:30	9:18:00	9:26:00	9:30:30
7:35:00	7:38:30	7:46:00	7:52:00	7:59:00	8:11:30	8:22:30	8:33:00	8:38:00	8:48:30	8:58:30	9:11:00	9:18:30	9:24:00	9:32:00	9:36:30
7:39:00	7:42:30	7:50:00	7:56:00	8:03:00	8:15:30	8:26:30	8:37:00	8:40:00	8:50:30	9:00:30	9:13:00	9:20:30	9:26:00	9:34:00	9:38:30
7:45:00	7:48:30	7:56:00	8:02:00	8:09:00	8:21:30	8:32:30	8:43:00	8:44:00	8:54:30	9:04:30	9:17:00	9:24:30	9:30:00	9:38:00	9:42:30
7:51:00	7:54:30	8:02:00	8:08:00	8:15:00	8:27:30	8:38:30	8:49:00	8:50:00	9:00:30	9:10:30	9:23:00	9:30:30	9:36:00	9:44:00	9:48:30
7:53:00	7:56:30	8:04:00	8:10:00	8:17:00	8:29:30	8:40:30	8:51:00	8:56:00	9:06:30	9:16:30	9:29:00	9:36:30	9:42:00	9:50:00	9:54:30
7:57:00	8:00:30	8:08:00	8:14:00	8:21:00	8:33:30	8:44:30	8:55:00	8:58:00	9:08:30	9:18:30	9:31:00	9:38:30	9:44:00	9:52:00	9:56:30
8:03:00	8:06:30	8:14:00	8:20:00	8:27:00	8:39:30	8:50:30	9:01:00	9:03:00	9:12:30	9:22:30	9:35:00	9:42:30	9:48:00	9:56:00	10:00:30
8:09:00	8:12:30	8:20:00	8:26:00	8:33:00	8:45:30	8:56:30	9:07:00	9:08:00	9:17:30	9:27:30	9:40:00	9:47:30	9:53:00	10:01:00	10:05:30
8:11:00	8:14:30	8:22:00	8:28:00	8:35:00	8:47:30	8:58:30	9:09:00	9:14:00	9:23:30	9:33:30	9:46:00	9:53:30	9:59:00	10:07:00	10:11:30
8:15:00	8:18:30	8:26:00	8:32:00	8:39:00	8:51:30	9:02:30	9:13:00	9:16:00	9:25:30	9:35:30	9:48:00	9:55:30	10:01:00	10:09:00	10:13:30
8:21:00	8:24:30	8:32:00	8:38:00	8:45:00	8:57:30	9:08:30	9:19:00	9:20:00	9:29:30	9:39:30	9:52:00	9:59:30	10:05:00	10:13:00	10:17:30
8:27:30	8:31:00	8:38:30	8:44:30	8:51:30	9:04:00	9:15:00	9:24:30	9:26:00	9:35:30	9:45:30	9:58:00	10:05:30	10:11:00	10:19:00	10:23:30
8:33:30	8:37:00	8:44:30	8:50:30	8:57:30	9:10:00	9:21:00	9:30:30	9:38:00	9:47:30	9:57:30	10:10:00	10:17:30	10:23:00	10:31:00	10:35:30
8:39:30	8:43:00	8:50:30	8:56:30	9:03:30	9:16:00	9:27:00	9:36:30	9:44:00	9:53:30	10:03:30	10:16:00	10:23:30	10:29:00	10:37:00	10:41:30
8:45:30	8:49:00	8:56:30	9:02:30	9:09:30	9:22:00	9:33:00	9:42:30								
8:51:30	8:55:00	9:02:30	9:08:30	9:15:30	9:28:00	9:39:00	9:48:30	9:56:00	10:05:30	10:15:30	10:28:00	10:35:30	10:41:00	10:49:00	10:53:30
8:57:30	9:01:00	9:08:30	9:14:30	9:21:30	9:34:00	9:45:00	9:54:30								
9:03:30	9:07:00	9:14:30	9:20:30	9:27:30	9:40:00	9:51:00	10:00:30	10:08:00	10:17:30	10:26:30	10:39:00	10:46:30	10:52:00	11:00:00	11:04:30
9:09:30	9:13:00	9:20:30	9:26:30	9:33:30	9:46:00	9:57:00	10:06:30	10:14:00	10:23:30	10:32:30	10:45:00	10:52:30	10:58:00	11:06:00	11:10:30
-	-	-	-	-	9:48:00	9:59:00	10:08:30								
9:15:30	9:19:00	9:26:30	9:32:30	9:39:30	9:52:00	10:03:00	10:12:30	10:20:00	10:29:30	10:38:30	10:51:00	10:58:30	11:04:00	11:12:00	11:16:30
9:28:00	9:31:30	9:39:00	9:45:00	9:52:00	10:04:30	10:15:00	10:24:00	10:32:00	10:41:30	10:50:30	11:03:00	11:10:30	11:16:00	11:24:00	11:28:30
9:34:00	9:37:30	9:45:00	9:51:00	9:58:00	10:10:30	10:21:00	10:30:00	10:38:00	10:47:30	10:56:30	11:09:00	11:16:30	11:22:00	11:30:00	11:34:30
-	-	-	-	-	10:12:00	10:22:30	10:31:30								
9:40:00	9:43:30	9:51:00	9:57:00	10:04:00	10:16:30	10:27:00	10:36:00								
9:46:00	9:49:30	9:57:00	10:03:00	10:10:00	10:22:30	10:33:00	10:42:00	10:50:00	10:59:30	11:08:30	11:21:00	11:28:30	11:34:00	11:42:00	11:46:30

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-3. Future Baseline (CBTC) Operating Plan – 3 Line – 7th Avenue Express – New Lots

148 Street	135 Street	96 Street 1 2 3	Times Sq - 42 Street	Chambers Street 1 2 3	Atlantic Avenue	Crown Heights - Utica Avenue	New Lots Avenue	New Lots Avenue	Crown Heights - Utica Avenue	Atlantic Avenue	Chambers Street 1 2 3	Times Sq - 42 Street	96 Street 1 2 3	135 Street	148 Street
9:52:00	9:55:30	10:03:00	10:09:00	10:16:00	10:28:30	10:39:00	10:48:00	10:56:00	11:05:30	11:14:30	11:27:00	11:34:30	11:40:00	11:48:00	11:52:30
9:58:00	10:01:30	10:09:00	10:15:00	10:22:00	10:34:30	10:45:00	10:54:00	11:02:00	11:11:30	11:20:30	11:33:00	11:40:30	11:46:00	11:54:00	11:58:30
10:04:00	10:07:30	10:15:00	10:21:00	10:28:00	10:40:30	10:51:00	11:00:00	11:08:00	11:17:30	11:26:30	11:39:00	11:46:30	11:52:00	12:00:00	12:04:30
10:10:00	10:13:30	10:21:00	10:27:00	10:34:00	10:46:30	10:57:00	11:06:00	11:14:00	11:23:30	11:32:30	11:45:00	11:52:30	11:58:00	12:06:00	12:10:30
10:16:00	10:19:30	10:27:00	10:33:00	10:40:00	10:52:30	11:03:00	11:12:00	11:20:00	11:29:30	11:38:30	11:51:00	11:58:30	12:04:00	12:12:00	12:16:30
10:28:00	10:31:30	10:39:00	10:45:00	10:52:00	11:04:30	11:15:00	11:24:00	11:32:00	11:41:30	11:50:30	12:03:00	12:10:30	12:16:00	12:24:00	12:28:30
10:34:00	10:37:30	10:45:00	10:51:00	10:58:00	11:10:30	11:21:00	11:30:00	11:38:00	11:47:30	11:56:30	12:09:00	12:16:30	12:22:00	12:30:00	12:34:30
10:46:00	10:49:30	10:57:00	11:03:00	11:10:00	11:22:30	11:33:00	11:42:00	11:50:00	11:59:30	12:08:30	12:21:00	12:28:30	12:34:00	12:42:00	12:46:30
10:52:00	10:55:30	11:03:00	11:09:00	11:16:00	11:28:30	11:39:00	11:48:00	11:56:00	12:05:30	12:14:30	12:27:00	12:34:30	12:40:00	12:48:00	12:52:30
10:58:00	11:01:30	11:09:00	11:15:00	11:22:00	11:34:30	11:45:00	11:54:00	12:02:00	12:11:30	12:20:30	12:33:00	12:40:30	12:46:00	12:54:00	12:58:30
11:10:00	11:13:30	11:21:00	11:27:00	11:34:00	11:46:30	11:57:00	12:06:00	12:14:00	12:23:30	12:32:30	12:45:00	12:52:30	12:58:00	13:06:00	13:10:30
11:16:00	11:19:30	11:27:00	11:33:00	11:40:00	11:52:30	12:03:00	12:12:00	12:20:00	12:29:30	12:38:30	12:51:00	12:58:30	13:04:00	13:12:00	13:16:30
11:22:00	11:25:30	11:33:00	11:39:00	11:46:00	11:58:30	12:09:00	12:18:00	12:26:00	12:35:30	12:44:30	12:57:00	13:04:30	13:10:00	13:18:00	13:22:30
11:34:00	11:37:30	11:45:00	11:51:00	11:58:00	12:10:30	12:21:00	12:30:00	12:38:00	12:47:30	12:56:30	13:09:00	13:16:30	13:22:00	13:30:00	13:34:30
11:40:00	11:43:30	11:51:00	11:57:00	12:04:00	12:16:30	12:27:00	12:36:00	12:44:00	12:53:30	13:02:30	13:15:00	13:22:30	13:28:00	13:36:00	13:40:30
11:46:00	11:49:30	11:57:00	12:03:00	12:10:00	12:22:30	12:33:00	12:42:00	12:50:00	12:59:30	13:08:30	13:21:00	13:28:30	13:34:00	13:42:00	13:46:30
11:54:00	11:57:30	12:05:00	12:11:00	12:18:00	12:30:30	12:41:00	12:50:00	12:58:00	13:07:30	13:16:30	13:29:00	13:36:30	13:42:00	13:50:00	13:54:30
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12:34:00	12:37:30	12:45:00	12:51:00	12:58:00	13:10:30	13:21:00	13:30:00	13:38:00	13:47:30	13:56:30	14:09:00	14:16:30	14:22:00	14:30:00	14:34:30
12:46:00	12:49:30	12:57:00	13:03:00	13:10:00	13:22:30	13:33:00	13:42:00	13:50:00	13:59:30	14:08:30	14:21:00	14:28:30	14:34:00	14:42:00	14:46:30
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12:58:00	13:01:30	13:09:00	13:15:00	13:22:00	13:34:30	13:45:00	13:54:00	14:02:00	14:11:30	14:20:30	14:33:00	14:40:30	14:46:00	14:54:00	14:58:30
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13:16:00	13:19:30	13:27:00	13:33:00	13:40:00	13:52:30	14:03:00	14:12:00	14:20:00	14:29:30	14:38:30	14:51:00	14:58:30	15:04:00	15:12:00	15:16:30
13:22:00	13:25:30	13:33:00	13:39:00	13:46:00	13:58:30	14:09:00	14:18:00	14:26:00	14:35:30	14:44:30	14:57:00	15:04:30	15:10:00	15:18:00	15:22:30
13:28:00	13:31:30	13:39:00	13:45:00	13:52:00	14:04:30	14:15:00	14:24:00	14:32:00	14:41:30	14:50:30	15:03:00	15:10:30	15:16:00	15:24:00	15:28:30
13:40:00	13:43:30	13:51:00	13:57:00	14:04:00	14:16:30	14:27:00	14:36:00	14:44:00	14:53:30	15:02:30	15:15:00	15:22:30	15:28:00	15:36:00	15:40:30
13:46:00	13:49:30	13:57:00	14:03:00	14:10:00	14:22:30	14:33:00	14:42:00	14:50:00	14:59:30	15:08:30	15:21:00	15:28:30	15:34:00	15:42:00	15:46:30
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APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-3. Future Baseline (CBTC) Operating Plan – 3 Line – 7th Avenue Express – New Lots

148 Street	135 Street	96 Street 1 2 3	Times Sq - 42 Street	Chambers Street 1 2 3	Atlantic Avenue	Crown Heights - Utica Avenue	New Lots Avenue	New Lots Avenue	Crown Heights - Utica Avenue	Atlantic Avenue	Chambers Street 1 2 3	Times Sq - 42 Street	96 Street 1 2 3	135 Street	148 Street
14:16:00	14:19:30	14:27:00	14:33:00	14:40:00	14:52:30	15:03:00	15:12:00	15:20:00	15:29:30	15:39:30	15:52:00	15:59:30	16:05:00	16:13:00	16:17:30
14:22:00	14:25:30	14:33:00	14:39:00	14:46:00	14:58:30	15:09:00	15:18:00	15:26:00	15:35:30	15:45:30	15:58:00	16:05:30	16:11:00	16:19:00	16:23:30
14:27:30	14:31:00	14:38:30	14:44:30	14:51:30	15:04:00	15:15:00	15:24:30	15:32:00	15:41:30	15:51:30	16:04:00	16:11:30	16:17:00	16:25:00	16:29:30
14:39:30	14:43:00	14:50:30	14:56:30	15:03:30	15:16:00	15:27:00	15:36:30	15:44:00	15:53:30	16:03:30	16:16:00	16:23:30	16:29:00	16:37:00	16:41:30
14:45:30	14:49:00	14:56:30	15:02:30	15:09:30	15:22:00	15:33:00	15:42:30	15:50:00	15:59:30	16:09:30	16:22:00	16:29:30	16:35:00	16:43:00	16:47:30
14:57:30	15:01:00	15:08:30	15:14:30	15:21:30	15:34:00	15:45:00	15:54:30	16:02:00	16:12:30	16:22:30	16:35:00	16:42:30	16:48:00	16:56:00	17:00:30
15:03:30	15:07:00	15:14:30	15:20:30	15:27:30	15:40:00	15:51:00	16:00:30	16:08:00	16:18:30	16:28:30	16:41:00	16:48:30	16:54:00	17:02:00	17:06:30
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15:21:30	15:25:00	15:32:30	15:38:30	15:45:30	15:58:00	16:09:00	16:18:30	16:26:00	16:36:30	16:46:30	16:59:00	17:06:30	17:12:00	17:20:00	17:24:30
15:27:00	15:30:30	15:38:00	15:44:00	15:51:00	16:03:30	16:14:30	16:25:00	16:32:00	16:42:30	16:52:30	17:05:00	17:12:30	17:18:00	17:26:00	17:30:30
15:33:00	15:36:30	15:44:00	15:50:00	15:57:00	16:09:30	16:20:30	16:31:00	16:38:00	16:48:30	16:58:30	17:11:00	17:18:30	17:24:00	17:32:00	17:36:30
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15:53:00	15:56:30	16:04:00	16:10:00	16:17:00	16:29:30	16:40:30	16:51:00	16:58:00	17:08:30	17:18:30	17:31:00	17:38:30	17:44:00	17:52:00	17:56:30
15:57:00	16:00:30	16:08:00	16:14:00	16:21:00	16:33:30	16:44:30	16:55:00	17:02:00	17:12:30	17:22:30	17:35:00	17:42:30	17:48:00	17:56:00	18:00:30
16:03:00	16:06:30	16:14:00	16:20:00	16:27:00	16:39:30	16:50:30	17:01:00	17:08:00	17:18:30	17:28:30	17:41:00	17:48:30	17:54:00	18:02:00	18:06:30
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16:11:00	16:14:30	16:22:00	16:28:00	16:35:00	16:47:30	16:58:30	17:09:00	17:16:00	17:26:30	17:36:30	17:49:00	17:56:30	18:02:00	18:10:00	18:14:30
16:15:00	16:18:30	16:26:00	16:32:00	16:39:00	16:51:30	17:02:30	17:13:00	17:20:00	17:30:30	17:40:30	17:53:00	18:00:30	18:06:00	18:14:00	18:18:30
16:21:00	16:24:30	16:32:00	16:38:00	16:45:00	16:57:30	17:08:30	17:19:00	17:26:00	17:36:30	17:46:30	17:59:00	18:06:30	18:12:00	18:20:00	18:24:30
16:33:00	16:36:30	16:44:00	16:50:00	16:57:00	17:09:30	17:20:30	17:31:00	17:32:00	17:42:30	17:52:30	18:05:00	18:12:30	18:18:00	18:26:00	18:30:30
16:35:00	16:38:30	16:46:00	16:52:00	16:59:00	17:11:30	17:22:30	17:33:00	17:38:00	17:48:30	17:58:30	18:11:00	18:18:30	18:24:00	18:32:00	18:36:30
16:39:00	16:42:30	16:50:00	16:56:00	17:03:00	17:15:30	17:26:30	17:37:00	17:40:00	17:50:30	18:00:30	18:13:00	18:20:30	18:26:00	18:34:00	18:38:30
16:45:00	16:48:30	16:56:00	17:02:00	17:09:00	17:21:30	17:32:30	17:43:00	17:44:00	17:54:30	18:04:30	18:17:00	18:24:30	18:30:00	18:38:00	18:42:30
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16:53:00	16:56:30	17:04:00	17:10:00	17:17:00	17:29:30	17:40:30	17:51:00	17:56:00	18:06:30	18:16:30	18:29:00	18:36:30	18:42:00	18:50:00	18:54:30
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APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-3. Future Baseline (CBTC) Operating Plan – 3 Line – 7th Avenue Express – New Lots

148 Street	135 Street	96 Street 1 2 3	Times Sq - 42 Street	Chambers Street 1 2 3	Atlantic Avenue	Crown Heights - Utica Avenue	New Lots Avenue	New Lots Avenue	Crown Heights - Utica Avenue	Atlantic Avenue	Chambers Street 1 2 3	Times Sq - 42 Street	96 Street 1 2 3	135 Street	148 Street
17:27:30	17:31:00	17:38:30	17:44:30	17:51:30	18:04:00	18:15:00	18:24:30	18:26:00	18:35:30	18:45:30	18:58:00	19:05:30	19:11:00	19:19:00	19:23:30
17:35:30	17:39:00	17:46:30	17:52:30	17:59:30	18:12:00	18:23:00	18:32:30	18:32:00	18:41:30	18:51:30	19:04:00	19:11:30	19:17:00	19:25:00	19:29:30
17:39:30	17:43:00	17:50:30	17:56:30	18:03:30	18:16:00	18:27:00	18:36:30	18:40:00	18:49:30	18:59:30	19:12:00	19:19:30	19:25:00	19:33:00	19:37:30
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17:57:30	18:01:00	18:08:30	18:14:30	18:21:30	18:34:00	18:45:00	18:54:30	19:02:00	19:11:30	19:20:30	19:33:00	19:40:30	19:46:00	19:54:00	19:58:30
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20:04:00	20:07:30	20:15:00	20:21:00	20:28:00	20:40:30	20:51:00	21:00:00	21:08:00	21:17:30	21:26:30	21:39:00	21:46:30	21:52:00	22:00:00	22:04:30
20:16:00	20:19:30	20:27:00	20:33:00	20:40:00	20:52:30	21:03:00	21:12:00	21:20:00	21:29:30	21:38:30	21:51:00	21:58:30	22:04:00	22:12:00	22:16:30
20:28:00	20:31:30	20:39:00	20:45:00	20:52:00	21:04:30	21:15:00	21:24:00	21:32:00	21:41:30	21:50:30	22:03:00	22:10:30	22:16:00	22:24:00	22:28:30
20:34:00	20:37:30	20:45:00	20:51:00	20:58:00	21:10:30	21:21:00	21:30:00	21:38:00	21:47:30	21:56:30	22:09:00	22:16:30	22:22:00	22:30:00	22:34:30
20:40:00	20:43:30	20:51:00	20:57:00	21:04:00	21:16:30	21:27:00	21:36:00	21:44:00	21:53:30	22:02:30	22:15:00	22:22:30	22:28:00	22:36:00	22:40:30
20:52:00	20:55:30	21:03:00	21:09:00	21:16:00	21:28:30	21:39:00	21:48:00	21:56:00	22:05:30	22:14:30	22:27:00	22:34:30	22:40:00	22:48:00	22:52:30
21:06:00	21:09:30	21:17:00	21:23:00	21:30:00	21:42:30	21:53:00	22:02:00	22:08:00	22:17:30	22:26:30	22:39:00	22:46:30	22:52:00	23:00:00	23:04:30
21:10:00	21:13:30	21:21:00	21:27:00	21:34:00	21:46:30	21:57:00	22:06:00	22:14:00	22:23:30	22:32:30	22:45:00	22:52:30	22:58:00	23:06:00	23:10:30
21:22:00	21:25:30	21:33:00	21:39:00	21:46:00	21:58:30	22:09:00	22:18:00	22:26:00	22:35:30	22:44:30	22:57:00	23:04:30	23:10:00	23:18:00	23:22:30
21:36:00	21:39:30	21:47:00	21:53:00	22:00:00	22:12:30	22:23:00	22:32:00								
21:40:00	21:43:30	21:51:00	21:57:00	22:04:00	22:16:30	22:27:00	22:36:00	22:44:00	22:53:30	23:02:30	23:15:00	23:22:30	23:28:00	23:36:00	23:40:30
21:54:00	21:57:30	22:05:00	22:11:00	22:18:00	22:30:30	22:41:00	22:50:00	22:58:00	23:07:30	23:16:30	23:29:00	23:36:30	23:42:00	23:50:00	23:54:30
22:10:00	22:13:30	22:21:00	22:27:00	22:34:00	22:46:30	22:57:00	23:06:00	23:14:00	23:23:30	23:32:30	23:45:00	23:52:30	23:58:00	24:06:00	24:10:30
22:22:00	22:25:30	22:33:00	22:39:00	22:46:00	22:58:30	23:09:00	23:18:00	23:26:00	23:35:30	23:44:30	23:57:00	24:04:30	24:10:00	24:18:00	24:22:30

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-3. Future Baseline (CBTC) Operating Plan – ③ Line – 7th Avenue Express – New Lots

148 Street	135 Street	96 Street ① ② ③	Times Sq - 42 Street	Chambers Street ① ② ③	Atlantic Avenue	Crown Heights - Utica Avenue	New Lots Avenue	New Lots Avenue	Crown Heights - Utica Avenue	Atlantic Avenue	Chambers Street ① ② ③	Times Sq - 42 Street	96 Street ① ② ③	135 Street	148 Street
22:35:00	22:38:30	22:46:00	22:52:00	22:59:00	23:11:30	23:22:00	23:31:00								
22:46:00	22:49:30	22:57:00	23:03:00	23:10:00	23:22:30	23:33:00	23:42:00								
22:58:00	23:01:30	23:09:00	23:15:00	23:22:00	23:34:30	23:45:00	23:54:00								
23:10:00	23:13:30	23:21:00	23:27:00	23:34:00	23:46:30	23:57:00	24:06:00								
23:30:00	23:33:30	23:41:00	23:47:00	-	-	-	-								
23:50:00	23:53:30	24:01:00	24:07:00	-	-	-	-	-	-	-	-	24:24:30	24:30:00	24:38:00	24:42:30
24:10:00	24:13:30	24:21:00	24:27:00	-	-	-	-								

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

G.2.4 4 Line Operating Plan

Table G.2-4. Future Baseline (CBTC) Operating Plan – 4 Line – Woodlawn-Lexington Avenue Express – Utica

Woodlawn	Bedford Pk Blvd	Kingsbridge Rd	125 Street	Brooklyn Bridge	Atlantic Avenue	Crown Heights - Utica Avenue	New Lots Avenue	New Lots Avenue	Crown Heights - Utica Avenue	Atlantic Avenue	Brooklyn Bridge	125 Street	Kingsbridge Rd	Bedford Pk Blvd	Woodlawn
							1:00:00	1:09:30	1:19:00	1:30:00	1:57:00	2:14:30	2:16:00	2:19:00	
							1:20:00	1:29:30	1:39:00	1:50:00	2:17:00	2:34:30	2:36:00	2:39:00	
0:14:00	0:17:00	0:18:30	0:36:00	0:52:30	1:03:30	1:14:00	1:24:30	1:40:00	1:49:30	1:59:00	2:10:00	2:37:00	2:54:30	2:56:00	2:59:00
0:23:00	0:26:00	0:27:30	0:45:00	1:13:30	1:24:30	1:35:00	1:45:30	2:00:00	2:09:30	2:19:00	2:30:00	2:57:00	3:14:30	3:16:00	3:19:00
0:43:00	0:46:00	0:47:30	1:05:00	1:33:30	1:44:30	1:55:00	2:05:30	2:20:00	2:29:30	2:39:00	2:50:00	3:17:00	3:34:30	3:36:00	3:39:00
1:03:00	1:06:00	1:07:30	1:25:00	1:53:30	2:04:30	2:15:00	2:25:30	2:40:00	2:49:30	2:59:00	3:10:00	3:37:00	3:54:30	3:56:00	3:59:00
1:23:00	1:26:00	1:27:30	1:45:00	2:13:30	2:24:30	2:35:00	2:45:30	3:00:00	3:09:30	3:19:00	3:30:00	3:57:00	4:14:30	4:16:00	4:19:00
1:43:00	1:46:00	1:47:30	2:05:00	2:33:30	2:44:30	2:55:00	3:05:30	3:20:00	3:29:30	3:39:00	3:50:00	4:17:00	4:34:30	4:36:00	4:39:00
2:03:00	2:06:00	2:07:30	2:25:00	2:53:30	3:04:30	3:15:00	3:25:30	3:40:00	3:49:30	3:59:00	4:10:00	4:37:00	4:54:30	4:56:00	4:59:00
2:23:00	2:26:00	2:27:30	2:45:00	3:13:30	3:24:30	3:35:00	3:45:30	4:00:00	4:09:30	4:19:00	4:30:00	4:57:00	5:14:30	5:16:00	5:19:00
2:43:00	2:46:00	2:47:30	3:05:00	3:33:30	3:44:30	3:55:00	4:05:30	4:20:00	4:29:30	4:39:00	4:50:00	5:17:00	5:34:30	5:36:00	5:39:00
3:03:00	3:06:00	3:07:30	3:25:00	3:53:30	4:04:30	4:15:00	4:25:30	4:40:00	4:49:30	4:59:00	5:10:00	5:37:00	5:54:30	5:56:00	5:59:00
3:23:00	3:26:00	3:27:30	3:45:00	4:13:30	4:24:30	4:35:00	4:45:30	5:00:00	5:09:30	5:19:00	5:30:00	5:46:00	6:03:30	6:05:00	6:08:00
							5:12:30	5:22:00	5:31:30	5:42:30	5:58:30	6:16:00	6:17:30	6:20:30	
3:43:00	3:46:00	3:47:30	4:05:00	4:33:30	4:44:30	4:55:00	5:05:30	5:20:00	5:29:30	5:39:00	5:50:00	6:06:00	6:23:30	6:25:00	6:28:00
3:58:00	4:01:00	4:02:30	4:20:00	4:48:30	4:59:30	5:10:00	5:20:30	5:32:30	5:42:00	5:51:30	6:02:30	6:18:30	6:36:00	6:37:30	6:40:30
4:08:00	4:11:00	4:12:30	4:30:00	4:58:30	5:09:30	5:20:00	5:30:30	5:44:00	5:53:30	6:03:00	6:14:00	6:30:00	6:47:30	6:49:00	6:52:00
4:18:00	4:21:00	4:22:30	4:40:00	5:08:30	5:19:30	5:30:00	5:40:30	5:50:30	6:00:00	6:09:30	6:21:00	6:37:30	6:55:30	6:57:00	7:00:00
4:40:30	4:43:30	4:45:00	5:02:30	5:19:00	5:30:00	5:40:30	5:51:00	5:59:00	6:08:30	6:18:00	6:29:30	6:46:00	7:04:00	7:05:30	7:08:30
4:52:30	4:55:30	4:57:00	5:14:30	5:31:00	5:42:00	5:52:30	6:03:00	6:17:30	6:27:00	6:33:30	6:45:00	7:01:30	7:19:30	7:21:00	7:24:00
5:06:30	5:09:30	5:11:00	5:28:30	5:45:00	5:56:00	6:04:00	-	-	6:22:30	6:29:00	6:40:30	6:57:00	7:15:00	7:16:30	7:19:30
5:20:30	5:23:30	5:25:00	5:42:30	5:59:00	6:10:00	6:18:00	-	-	6:31:30	6:38:00	6:49:30	7:06:00	7:24:00	7:25:30	7:28:30
5:26:30	5:29:30	5:31:00	5:48:30	6:05:00	6:16:00	6:24:00	-	-	6:36:30	6:43:00	6:54:30	7:11:00	7:29:00	7:30:30	7:33:30
5:34:30	5:37:30	5:39:00	5:56:30	6:13:00	6:24:00	6:32:00	-	-	6:42:30	6:49:00	7:00:30	7:17:00	7:35:00	7:36:30	7:39:30
5:45:30	5:48:30	5:50:00	6:07:30	6:24:00	6:35:30	6:44:00	-	-	6:50:30	6:57:00	7:08:30	7:25:00	7:43:00	7:44:30	7:47:30
							6:59:30	7:09:00	7:15:30	7:27:00	7:44:00	8:02:00	8:03:30	8:06:30	
5:55:30	5:58:30	6:00:00	6:17:30	6:34:00	6:45:30	6:54:00	-	-	7:02:30	7:09:00	7:20:30	7:37:30	7:55:30	7:57:00	8:00:00
							7:11:30	7:21:00	7:27:30	7:39:00	7:56:00	8:14:00	8:15:30	8:18:30	
6:01:30	6:04:30	6:06:00	6:23:30	6:40:00	6:51:30	7:00:00	-	-	7:12:30	7:19:00	7:30:30	7:47:30	8:05:30	8:07:00	8:10:00
6:07:30	6:10:30	6:12:00	6:29:30	6:46:00	6:57:30	7:06:00	-	-	7:18:30	7:25:00	7:36:30	7:53:30	8:11:30	8:13:00	8:16:00
6:13:30	6:16:30	6:18:00	6:35:30	6:52:00	7:03:30	7:12:00	-	-	7:24:30	7:31:00	7:42:30	7:59:30	8:17:30	8:19:00	8:22:00
6:19:30	6:22:30	6:24:00	6:41:30	6:58:00	7:09:30	7:18:00	-	-	7:30:30	7:37:00	7:48:30	8:05:30	8:23:30	8:25:00	8:28:00
6:25:30	6:28:30	6:30:00	6:47:30	7:04:00	7:15:30	7:24:00	-	-	7:36:30	7:43:00	7:54:30	8:11:30	8:29:30	8:31:00	8:34:00
-	6:30:00	6:31:30	6:49:30	7:06:00	7:17:30	7:26:00	-	-	7:42:30	7:49:00	8:00:30	8:17:30	8:35:30	8:37:00	8:40:00

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-4. Future Baseline (CBTC) Operating Plan – 4 Line – Woodlawn-Lexington Avenue Express – Utica

Woodlawn	Bedford Pk Blvd	Kingsbridge Rd	125 Street	Brooklyn Bridge	Atlantic Avenue	Crown Heights - Utica Avenue	New Lots Avenue	New Lots Avenue	Crown Heights - Utica Avenue	Atlantic Avenue	Brooklyn Bridge	125 Street	Kingsbridge Rd	Bedford Pk Blvd	Woodlawn
6:33:00	6:36:00	6:37:30	6:55:30	7:12:00	7:23:30	7:32:00	-	-	7:44:30	7:51:00	8:02:30	8:19:30	8:37:30	8:39:00	8:42:00
6:37:00	6:40:00	6:42:00	7:00:00	7:16:30	7:28:00	7:37:00	-	-	7:48:30	7:55:00	8:06:30	8:23:30	8:41:30	8:43:00	8:46:00
									7:50:30	7:57:00	8:08:30	8:25:30	8:43:30	8:45:00	8:48:00
6:43:00	6:46:00	6:48:00	7:06:00	7:22:30	7:34:00	7:43:00	-	-	7:56:30	8:03:00	8:14:30	8:31:30	8:49:30	8:51:00	8:54:00
-	6:44:00	6:46:00	7:04:00	7:20:30	7:32:00	7:41:00	-								
-	6:50:00	6:52:00	7:10:00	7:26:30	7:38:00	7:47:00	-	-	8:02:30	8:09:00	8:20:30	8:37:30	8:55:30	8:57:00	9:00:00
6:49:00	6:52:00	6:54:00	7:12:00	7:28:30	7:40:00	7:49:00	-	-	8:04:30	8:11:00	8:22:30	8:39:30	8:57:30	-	-
-	-	6:58:00	7:16:00	7:32:30	7:44:00	7:53:00	-	-	8:06:30	8:13:00	8:24:30	8:41:30	8:59:30	9:01:00	-
6:55:00	6:58:00	7:00:00	7:18:00	7:34:30	7:46:00	7:55:00	-	-	8:08:30	8:15:00	8:26:30	8:43:30	9:01:30	9:03:00	9:06:00
7:01:00	7:04:00	7:06:00	7:24:00	7:40:30	7:52:00	8:01:00	-	-	8:14:30	8:21:00	8:32:30	8:49:30	9:07:30	9:09:00	9:12:00
7:03:00	7:06:00	7:08:00	7:26:00	7:42:30	7:54:00	8:03:00	-	-	8:18:30	8:25:00	8:36:30	8:53:30	9:11:30	-	-
-	7:08:00	7:10:00	7:28:00	7:44:30	7:56:00	8:05:00	-	-	8:20:30	8:27:00	8:38:30	8:55:30	9:13:30	9:15:00	9:18:00
-	-	7:12:00	7:30:00	7:46:30	7:58:00	8:07:00	-	-	8:22:30	8:29:00	8:40:30	8:57:30	9:15:30	9:17:00	-
7:11:00	7:14:00	7:16:00	7:34:00	7:50:30	8:02:00	8:11:00	-	-	8:24:30	8:31:00	8:42:30	8:59:30	9:17:30	9:19:00	9:22:00
7:13:00	7:16:00	7:18:00	7:36:00	7:52:30	8:04:00	8:13:00	-	-	8:26:30	8:33:00	8:44:30	9:01:30	9:19:30	9:21:00	-
-	-	7:22:00	7:40:00	7:56:30	8:08:00	8:17:00	-	-	8:30:30	8:37:00	8:48:30	9:05:30	9:21:00	9:22:30	9:25:30
-	7:22:00	7:24:00	7:42:00	7:58:30	8:10:00	8:19:00	-	-	8:32:30	8:39:00	8:50:30	9:07:30	9:25:30	9:27:00	9:30:00
7:23:00	7:26:00	7:28:00	7:46:00	8:02:30	8:14:00	8:23:00	-	-	8:36:30	8:43:00	8:54:30	9:11:30	9:29:30	9:31:00	9:34:00
-	-	7:30:00	7:48:00	8:04:30	8:16:00	8:25:00	-	-	8:38:30	8:45:00	8:56:30	9:13:30	9:31:30	9:33:00	9:36:00
7:27:00	7:30:00	7:32:00	7:50:00	8:06:30	8:18:00	8:27:00	-	-	8:42:30	8:49:00	9:00:30	9:17:30	9:35:30	-	-
7:29:00	7:32:00	7:34:00	7:52:00	8:08:30	8:20:00	8:29:00	-	-	8:44:30	8:51:00	9:02:30	9:19:30	9:35:00	9:36:30	-
7:31:00	7:34:00	7:36:00	7:54:00	8:10:30	8:22:00	8:31:00	-	-	8:46:30	8:53:00	9:04:30	9:21:30	9:39:30	9:41:00	9:44:00
7:37:00	7:40:00	7:42:00	8:00:00	8:16:30	8:28:00	8:37:00	-	-	8:50:30	8:57:00	9:08:30	9:25:30	9:43:30	9:45:00	9:48:00
7:41:00	7:44:00	7:46:00	8:04:00	8:20:30	8:32:00	8:41:00	-	-	8:54:30	9:01:00	9:12:30	9:29:30	9:47:30	9:49:00	-
7:43:00	7:46:00	7:48:00	8:06:00	8:22:30	8:34:00	8:43:00	-	-	8:56:30	9:03:00	9:14:30	9:31:30	9:49:30	-	-
-	7:48:00	7:50:00	8:08:00	8:24:30	8:36:00	8:45:00	-	-	9:00:30	9:07:00	9:18:30	9:35:30	9:51:00	9:52:30	-
-	-	7:52:00	8:10:00	8:26:30	8:38:00	8:47:00	-	-	9:01:30	9:08:00	9:19:30	9:36:30	9:54:30	9:56:00	9:59:00
7:53:00	7:56:00	7:58:00	8:16:00	8:32:30	8:44:00	8:53:00	-	-	9:06:30	9:13:00	9:24:30	9:41:00	9:59:00	10:00:30	-
7:55:00	7:58:00	8:00:00	8:18:00	8:34:30	8:46:00	8:55:00	-	-	9:08:30	9:15:00	9:26:30	9:43:00	10:01:00	10:02:30	10:05:30
-	8:02:00	8:04:00	8:22:00	8:38:30	8:50:00	8:59:00	-	-	9:12:30	9:19:00	9:30:30	9:47:00	10:05:00	-	-
-	-	8:06:00	8:24:00	8:40:30	8:52:00	9:01:00	-	-	9:14:30	9:21:00	9:32:30	9:49:00	10:07:00	10:08:30	-
8:05:00	8:08:00	8:10:00	8:28:00	8:44:30	8:56:00	9:05:00	-	-	9:20:30	9:27:00	9:38:30	9:55:00	10:13:00	10:14:30	10:17:30
8:07:00	8:10:00	8:12:00	8:30:00	8:46:30	8:58:00	9:07:00	-	-	9:22:30	9:29:00	9:40:30	9:57:00	10:15:00	-	-
8:11:00	8:14:00	8:16:00	8:34:00	8:50:30	9:02:00	9:11:00	-	-	9:24:30	9:31:00	9:42:30	9:59:00	10:17:00	10:18:30	-
8:13:00	8:16:00	8:18:00	8:36:00	8:52:30	9:04:00	9:13:00	-	-	9:26:30	9:33:00	9:44:30	10:01:00	10:19:00	10:20:30	10:23:30
-	8:20:00	8:22:00	8:40:00	8:56:30	9:08:00	9:17:00	-	-	9:30:30	9:37:00	9:48:30	10:05:00	10:23:00	10:24:30	10:27:30

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-4. Future Baseline (CBTC) Operating Plan – 4 Line – Woodlawn-Lexington Avenue Express – Utica

Woodlawn	Bedford Pk Blvd	Kingsbridge Rd	125 Street	Brooklyn Bridge	Atlantic Avenue	Crown Heights - Utica Avenue	New Lots Avenue	New Lots Avenue	Crown Heights - Utica Avenue	Atlantic Avenue	Brooklyn Bridge	125 Street	Kingsbridge Rd	Bedford Pk Blvd	Woodlawn
8:19:00	8:22:00	8:24:00	8:42:00	8:58:30	9:10:00	9:19:00	-	-	9:32:30	9:39:00	9:50:30	10:07:00	10:25:00	10:26:30	10:29:30
8:23:00	8:26:00	8:28:00	8:46:00	9:02:30	9:14:00	9:23:00	-	-	9:36:30	9:43:00	9:54:30	10:11:00	10:29:00	-	-
8:25:00	8:28:00	8:30:00	8:48:00	9:04:30	9:16:00	9:25:00	-	-	9:38:30	9:45:00	9:56:30	10:13:00	10:31:00	10:32:30	-
8:27:00	8:30:00	8:32:00	8:50:00	9:06:30	9:18:00	9:27:00	-	-	9:40:30	9:47:00	9:58:30	10:15:00	10:33:00	10:34:30	10:37:30
-	8:32:00	8:34:00	8:52:00	9:08:30	9:20:00	9:29:00	-	-	9:44:30	9:51:00	10:02:30	10:19:00	10:34:30	10:36:00	10:39:00
8:31:00	8:34:00	8:36:00	8:54:00	9:10:30	9:22:00	9:31:00	-	-	9:48:30	9:55:00	10:06:30	10:23:00	10:41:00	10:42:30	-
8:35:30	8:38:30	8:40:30	8:58:00	9:14:30	9:26:00	9:35:00	9:51:00								
8:39:00	8:42:00	8:43:30	9:01:00	9:17:30	9:29:00	9:37:30	-	-	9:50:30	9:57:00	10:08:30	10:25:00	10:43:00	10:44:30	10:47:30
8:43:00	8:46:00	8:47:30	9:05:00	9:21:30	9:33:00	9:41:30	9:57:00								
8:45:00	8:48:00	8:49:30	9:07:00	9:23:30	9:35:00	9:43:30	-	-	9:56:30	10:03:00	10:14:30	10:31:00	10:46:30	10:48:00	10:51:00
8:51:00	8:54:00	8:55:30	9:13:00	9:29:30	9:41:00	9:49:30	-	-	10:01:30	10:08:00	10:19:00	10:35:00	10:52:30	10:54:00	10:57:00
8:57:00	9:00:00	9:01:30	9:19:00	9:35:30	9:47:00	9:55:30	-	-	10:07:00	10:13:30	10:24:30	10:40:30	10:55:30	10:57:00	11:00:00
9:03:00	9:06:00	9:07:30	9:25:00	9:41:30	9:53:00	10:01:30	-	-	10:13:00	10:19:30	10:30:30	10:46:30	11:04:00	11:05:30	11:08:30
9:09:00	9:12:00	9:13:30	9:31:00	9:47:30	9:59:00	10:07:30	-	-	10:19:00	10:25:30	10:36:30	10:52:30	11:07:30	11:09:00	11:12:00
9:15:00	9:18:00	9:19:30	9:37:00	9:53:30	10:05:00	10:13:30	-	-	10:25:00	10:31:30	10:42:30	10:58:30	11:16:00	11:17:30	11:20:30
9:21:00	9:24:00	9:25:30	9:43:00	9:59:30	10:11:00	10:19:30	-	-	10:31:00	10:37:30	10:48:30	11:04:30	11:22:00	11:23:30	11:26:30
9:29:00	9:32:00	9:33:30	9:51:00	10:07:30	10:19:00	10:27:30	-	-	10:37:00	10:43:30	10:54:30	11:10:30	11:25:30	11:27:00	11:30:00
9:33:00	9:36:00	9:37:30	9:55:00	10:11:30	10:23:00	10:31:30	-	-	10:45:00	10:51:30	11:02:30	11:18:30	11:36:00	11:37:30	11:40:30
9:38:30	9:41:30	9:43:00	10:00:30	10:17:00	10:28:00	10:36:00	-	-	10:49:00	10:55:30	11:06:30	11:22:30	11:40:00	11:41:30	11:44:30
9:46:30	9:49:30	9:51:00	10:08:30	10:25:00	10:36:00	10:44:00	-	-	10:53:00	10:59:30	11:10:30	11:26:30	11:41:30	11:43:00	11:46:00
9:52:30	9:55:30	9:57:00	10:14:30	10:31:00	10:42:00	10:50:00	-	-	11:01:00	11:07:30	11:18:30	11:34:30	11:52:00	11:53:30	11:56:30
10:02:30	10:05:30	10:07:00	10:24:30	10:41:00	10:52:00	11:00:00	-	-	11:07:00	11:13:30	11:24:30	11:40:30	11:58:00	11:59:30	12:02:30
10:10:30	10:13:30	10:15:00	10:32:30	10:49:00	11:00:00	11:08:00	-	-	11:17:00	11:23:30	11:34:30	11:50:30	12:08:00	12:09:30	12:12:30
10:20:30	10:23:30	10:25:00	10:42:30	10:59:00	11:10:00	11:18:00	-	-	11:25:00	11:31:30	11:42:30	11:58:30	12:16:00	12:17:30	12:20:30
10:26:30	10:29:30	10:31:00	10:48:30	11:05:00	11:16:00	11:24:00	-	-	11:35:00	11:41:30	11:52:30	12:08:30	12:26:00	12:27:30	12:30:30
10:34:30	10:37:30	10:39:00	10:56:30	11:13:00	11:24:00	11:32:00	-	-	11:41:00	11:47:30	11:58:30	12:14:30	12:32:00	12:33:30	12:36:30
10:40:30	10:43:30	10:45:00	11:02:30	11:19:00	11:30:00	11:38:00	-	-	11:49:00	11:55:30	12:06:30	12:22:30	12:40:00	12:41:30	12:44:30
10:50:30	10:53:30	10:55:00	11:12:30	11:29:00	11:40:00	11:48:00	-	-	11:55:00	12:01:30	12:12:30	12:28:30	12:46:00	12:47:30	12:50:30
10:58:30	11:01:30	11:03:00	11:20:30	11:37:00	11:48:00	11:56:00	-	-	12:05:00	12:11:30	12:22:30	12:38:30	12:56:00	12:57:30	13:00:30
11:06:30	11:09:30	11:11:00	11:28:30	11:45:00	11:56:00	12:04:00	-	-	12:13:00	12:19:30	12:30:30	12:46:30	13:04:00	13:05:30	13:08:30
11:14:30	11:17:30	11:19:00	11:36:30	11:53:00	12:04:00	12:12:00	-	-	12:21:00	12:27:30	12:38:30	12:54:30	13:12:00	13:13:30	13:16:30
11:22:30	11:25:30	11:27:00	11:44:30	12:01:00	12:12:00	12:20:00	-	-	12:29:00	12:35:30	12:46:30	13:02:30	13:20:00	13:21:30	13:24:30
11:30:30	11:33:30	11:35:00	11:52:30	12:09:00	12:20:00	12:28:00	-	-	12:37:00	12:43:30	12:54:30	13:10:30	13:28:00	13:29:30	13:32:30
11:38:30	11:41:30	11:43:00	12:00:30	12:17:00	12:28:00	12:36:00	-	-	12:45:00	12:51:30	13:02:30	13:18:30	13:36:00	13:37:30	13:40:30
11:46:30	11:49:30	11:51:00	12:08:30	12:25:00	12:36:00	12:44:00	-	-	12:53:00	12:59:30	13:10:30	13:26:30	13:44:00	13:45:30	13:48:30
11:56:30	11:59:30	12:01:00	12:18:30	12:35:00	12:46:00	12:54:00	-	-	13:01:00	13:07:30	13:18:30	13:34:30	13:52:00	13:53:30	13:56:30

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-4. Future Baseline (CBTC) Operating Plan – 4 Line – Woodlawn-Lexington Avenue Express – Utica

Woodlawn	Bedford Pk Blvd	Kingsbridge Rd	125 Street	Brooklyn Bridge	Atlantic Avenue	Crown Heights - Utica Avenue	New Lots Avenue	New Lots Avenue	Crown Heights - Utica Avenue	Atlantic Avenue	Brooklyn Bridge	125 Street	Kingsbridge Rd	Bedford Pk Blvd	Woodlawn
12:02:30	12:05:30	12:07:00	12:24:30	12:41:00	12:52:00	13:00:00	-	-	13:11:00	13:17:30	13:28:30	13:44:30	14:02:00	14:03:30	14:06:30
12:10:30	12:13:30	12:15:00	12:32:30	12:49:00	13:00:00	13:08:00	-	-	13:17:00	13:23:30	13:34:30	13:50:30	14:08:00	14:09:30	14:12:30
12:20:30	12:23:30	12:25:00	12:42:30	12:59:00	13:10:00	13:18:00	-	-	13:25:00	13:31:30	13:42:30	13:58:30	14:16:00	14:17:30	14:20:30
12:26:30	12:29:30	12:31:00	12:48:30	13:05:00	13:16:00	13:24:00	-	-	13:35:00	13:41:30	13:52:30	14:08:30	14:26:00	14:27:30	14:30:30
12:34:30	12:37:30	12:39:00	12:56:30	13:13:00	13:24:00	13:32:00	-	-	13:41:00	13:47:30	13:58:30	14:14:30	14:32:00	14:33:30	14:36:30
12:40:30	12:43:30	12:45:00	13:02:30	13:19:00	13:30:00	13:38:00	-	-	13:49:00	13:55:30	14:06:30	14:22:30	14:40:00	14:41:30	14:44:30
12:50:30	12:53:30	12:55:00	13:12:30	13:29:00	13:40:00	13:48:00	-	-	13:55:00	14:01:30	14:12:30	14:28:30	14:46:00	14:47:30	14:50:30
12:58:30	13:01:30	13:03:00	13:20:30	13:37:00	13:48:00	13:56:00	-	-	14:05:00	14:11:30	14:22:30	14:38:30	14:56:00	14:57:30	15:00:30
13:06:30	13:09:30	13:11:00	13:28:30	13:45:00	13:56:00	14:04:00	-	-	14:13:00	14:19:30	14:30:30	14:46:30	15:04:00	15:05:30	15:08:30
13:14:30	13:17:30	13:19:00	13:36:30	13:53:00	14:04:00	14:12:00	-	-	14:21:00	14:27:30	14:38:30	14:54:30	15:12:00	15:13:30	15:16:30
13:22:30	13:25:30	13:27:00	13:44:30	14:01:00	14:12:00	14:20:00	-	-	14:29:00	14:35:30	14:46:30	15:02:30	15:20:00	15:21:30	15:24:30
13:30:30	13:33:30	13:35:00	13:52:30	14:09:00	14:20:00	14:28:00	-	-	14:37:00	14:43:30	14:54:30	15:10:30	15:28:00	15:29:30	15:32:30
13:38:30	13:41:30	13:43:00	14:00:30	14:17:00	14:28:00	14:36:00	-	-	14:45:00	14:51:30	15:02:30	15:18:30	15:36:00	15:37:30	15:40:30
13:46:30	13:49:30	13:51:00	14:08:30	14:25:00	14:36:00	14:44:00	-	-	14:53:00	14:59:30	15:10:30	15:26:30	15:44:00	15:45:30	15:48:30
13:56:30	13:59:30	14:01:00	14:18:30	14:35:00	14:46:00	14:54:00	-	-	15:01:00	15:07:30	15:19:00	15:35:30	15:53:30	15:55:00	15:58:00
								15:07:30	15:17:00	15:23:30	15:35:00	15:51:30	16:09:30	16:11:00	16:14:00
14:02:30	14:05:30	14:07:00	14:24:30	14:41:00	14:52:00	15:00:00	-	-	15:12:30	15:19:00	15:30:30	15:47:00	16:05:00	16:06:30	16:09:30
14:10:30	14:13:30	14:15:00	14:32:30	14:49:00	15:00:00	15:08:00	-	-	15:18:30	15:25:00	15:36:30	15:53:00	16:11:00	16:12:30	16:15:30
14:16:30	14:19:30	14:21:00	14:38:30	14:55:00	15:06:00	15:14:00	-	-	15:26:30	15:33:00	15:44:30	16:01:00	16:19:00	16:20:30	16:23:30
14:22:30	14:25:30	14:27:00	14:44:30	15:01:00	15:12:00	15:20:00	-	-	15:32:30	15:39:00	15:50:30	16:07:00	16:25:00	16:26:30	16:29:30
								15:35:30	15:45:00	15:51:30	16:03:00	16:19:30	16:37:30	16:39:00	16:42:00
14:30:30	14:33:30	14:35:00	14:52:30	15:09:00	15:20:00	15:28:00	-	-	15:38:30	15:45:00	15:56:30	16:13:00	16:31:00	16:32:30	16:35:30
-	14:35:30	14:37:00	14:54:30	15:11:00	15:22:00	15:30:00	-	-	15:46:30	15:53:00	16:04:30	16:21:00	16:39:00	16:40:30	16:43:30
14:34:30	14:37:30	14:39:00	14:56:30	15:13:00	15:24:00	15:32:00	-	-	15:56:30	16:03:00	16:14:30	16:31:00	16:49:00	16:50:30	16:53:30
14:45:00	14:48:00	14:49:30	15:07:00	15:23:30	15:35:00	15:43:30	-	-	16:00:30	16:07:00	16:18:30	16:35:00	16:53:00	16:54:30	16:57:30
14:49:00	14:52:00	14:53:30	15:11:00	15:27:30	15:39:00	15:47:30	-	-	16:02:30	16:09:00	16:20:30	16:37:30	16:55:30	16:57:00	17:00:00
14:51:00	14:54:00	14:55:30	15:13:00	15:29:30	15:41:00	15:49:30	-	-	16:04:30	16:11:00	16:22:30	16:39:30	16:57:30	16:59:00	17:02:00
14:55:00	14:58:00	14:59:30	15:17:00	15:33:30	15:45:00	15:53:30	-	-	16:06:30	16:13:00	16:24:30	16:41:30	16:59:30	17:01:00	17:04:00
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-	15:04:00	15:05:30	15:23:00	15:39:30	15:51:00	15:59:30	-	-	16:12:30	16:19:00	16:30:30	16:47:30	17:05:30	17:07:00	17:10:00
15:03:00	15:06:00	15:07:30	15:25:00	15:41:30	15:53:00	16:01:30	-	-	16:14:30	16:21:00	16:32:30	16:49:30	17:07:00	-	-
15:05:00	15:08:00	15:09:30	15:27:00	15:43:30	15:55:00	16:03:30	-	-	16:18:30	16:25:00	16:36:30	16:53:30	17:11:00	17:12:30	17:15:30
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15:13:00	15:16:00	15:17:30	15:35:00	15:51:30	16:03:00	16:11:30	-	-	16:24:30	16:31:00	16:42:30	16:59:30	17:17:00	17:18:30	17:21:30
15:15:00	15:18:00	15:19:30	15:37:00	15:53:30	16:05:00	16:13:30	-	-	16:26:30	16:33:00	16:44:30	17:01:30	17:19:00	17:20:30	17:23:30

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-4. Future Baseline (CBTC) Operating Plan – 4 Line – Woodlawn-Lexington Avenue Express – Utica

Woodlawn	Bedford Pk Blvd	Kingsbridge Rd	125 Street	Brooklyn Bridge	Atlantic Avenue	Crown Heights - Utica Avenue	New Lots Avenue	New Lots Avenue	Crown Heights - Utica Avenue	Atlantic Avenue	Brooklyn Bridge	125 Street	Kingsbridge Rd	Bedford Pk Blvd	Woodlawn
-	15:22:00	15:23:30	15:41:00	15:57:30	16:09:00	16:17:30	-	-	16:30:30	16:37:00	16:48:30	17:05:30	17:23:00	-	-
15:21:00	15:24:00	15:25:30	15:43:00	15:59:30	16:11:00	16:19:30	-	-	16:32:30	16:39:00	16:50:30	17:07:30	17:25:00	17:26:30	17:29:30
-	15:28:00	15:29:30	15:47:00	16:03:30	16:15:00	16:23:30	-	-	16:36:30	16:43:00	16:54:30	17:11:30	17:29:00	17:30:30	-
15:27:00	15:30:00	15:31:30	15:49:00	16:05:30	16:17:00	16:25:30	-	-	16:38:30	16:45:00	16:56:30	17:13:30	17:31:00	17:32:30	17:35:30
15:29:00	15:32:00	15:33:30	15:51:00	16:07:30	16:19:00	16:27:30	-	-	16:42:30	16:49:00	17:00:30	17:17:30	17:35:00	17:36:30	17:39:30
-	15:35:30	15:37:30	15:55:00	16:11:30	16:23:00	16:32:00	-	-	16:46:30	16:53:00	17:04:30	17:21:30	17:39:00	17:40:30	-
15:37:30	15:40:30	15:42:30	16:00:00	16:16:30	16:28:00	16:37:00	-	-	16:48:30	16:55:00	17:06:30	17:23:30	17:41:00	17:42:30	17:45:30
15:39:30	15:42:30	15:44:30	16:02:00	16:18:30	16:30:00	16:39:00	-	-	16:50:30	16:57:00	17:08:30	17:25:30	17:43:00	-	-
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-	15:46:30	15:48:30	16:06:00	16:22:30	16:34:00	16:43:00	-	-	16:56:30	17:03:00	17:14:30	17:31:30	17:49:00	17:50:30	17:53:30
-	-	15:52:30	16:10:00	16:26:30	16:38:00	16:47:00	-	-	17:02:30	17:09:00	17:20:30	17:37:30	17:55:00	-	-
-	15:52:30	15:54:30	16:12:00	16:28:30	16:40:00	16:49:00	-	-	17:04:30	17:11:00	17:22:30	17:39:30	17:57:00	17:58:30	18:01:30
15:53:30	15:56:30	15:58:30	16:16:00	16:32:30	16:44:00	16:53:00	-	-	17:06:30	17:13:00	17:24:30	17:41:30	17:59:00	18:00:30	18:03:30
15:55:30	15:58:30	16:00:30	16:18:00	16:34:30	16:46:00	16:55:00	-	-	17:08:30	17:15:00	17:26:30	17:43:30	18:01:00	18:02:30	-
16:01:30	16:04:30	16:06:30	16:24:00	16:40:30	16:52:00	17:01:00	-	-	17:14:30	17:21:00	17:32:30	17:49:30	18:07:00	18:08:30	18:11:30
-	-	16:08:30	16:26:00	16:42:30	16:54:00	17:03:00	-	-	17:18:30	17:25:00	17:36:30	17:53:30	18:11:00	18:12:30	-
-	16:08:30	16:10:30	16:28:00	16:44:30	16:56:00	17:05:00	-	-	17:20:30	17:27:00	17:38:30	17:55:30	18:13:00	-	-
16:07:30	16:10:30	16:12:30	16:30:00	16:46:30	16:58:00	17:07:00	-	-	17:22:30	17:29:00	17:40:30	17:57:30	18:15:00	18:16:30	-
16:11:30	16:14:30	16:16:30	16:34:00	16:50:30	17:02:00	17:11:00	-	-	17:24:30	17:31:00	17:42:30	17:59:30	18:17:00	18:18:30	18:21:30
-	16:16:30	16:18:30	16:36:00	16:52:30	17:04:00	17:13:00	-	-	17:26:30	17:33:00	17:44:30	18:01:30	18:19:00	18:20:30	18:23:30
16:17:30	16:20:30	16:22:30	16:40:00	16:56:30	17:08:00	17:17:00	-	-	17:30:30	17:37:00	17:48:30	18:05:30	18:23:00	18:24:30	18:27:30
16:19:30	16:22:30	16:24:30	16:42:00	16:58:30	17:10:00	17:19:00	-	-	17:32:30	17:39:00	17:50:30	18:07:30	18:25:00	18:26:30	-
16:23:30	16:26:30	16:28:30	16:46:00	17:02:30	17:14:00	17:23:00	-	-	17:36:30	17:43:00	17:54:30	18:11:30	18:29:00	-	-
16:25:30	16:28:30	16:30:30	16:48:00	17:04:30	17:16:00	17:25:00	-	-	17:38:30	17:45:00	17:56:30	18:13:30	18:31:00	18:32:30	18:35:30
-	16:32:30	16:34:30	16:52:00	17:08:30	17:20:00	17:29:00	-	-	17:44:30	17:51:00	18:02:30	18:19:30	18:37:00	18:38:30	18:41:30
16:31:30	16:34:30	16:36:30	16:54:00	17:10:30	17:22:00	17:31:00	-	-	17:46:30	17:53:00	18:04:30	18:21:30	18:39:00	18:40:30	-
16:35:30	16:38:30	16:40:30	16:58:00	17:14:30	17:26:00	17:35:00	-	-	17:48:30	17:55:00	18:06:30	18:23:30	18:41:00	-	-
16:37:30	16:40:30	16:42:30	17:00:00	17:16:30	17:28:00	17:37:00	-	-	17:50:30	17:57:00	18:08:30	18:25:30	18:43:00	18:44:30	18:47:30
-	16:44:30	16:46:30	17:04:00	17:20:30	17:32:00	17:41:00	-	-	17:54:30	18:01:00	18:12:30	18:29:30	18:45:00	18:46:30	-
16:45:30	16:48:30	16:50:30	17:08:00	17:24:30	17:36:00	17:45:00	-	-	17:56:30	18:03:00	18:14:30	18:31:30	18:49:30	18:51:00	18:54:00
16:47:30	16:50:30	16:52:30	17:10:00	17:26:30	17:38:00	17:47:00	-	-	18:00:30	18:07:00	18:18:30	18:35:30	18:53:30	18:55:00	18:58:00
16:49:30	16:52:30	16:54:30	17:12:00	17:28:30	17:40:00	17:49:00	-	-	18:04:30	18:11:00	18:22:30	18:39:00	18:57:00	18:58:30	19:01:30
-	16:56:30	16:58:30	17:16:00	17:32:30	17:44:00	17:53:00	-	-	18:06:30	18:13:00	18:24:30	18:41:00	18:59:00	-	-
16:55:30	16:58:30	17:00:30	17:18:00	17:34:30	17:46:00	17:55:00	-	-	18:08:30	18:15:00	18:26:30	18:43:00	19:01:00	19:02:30	19:05:30
16:59:30	17:02:30	17:04:30	17:22:00	17:38:30	17:50:00	17:59:00	-	-	18:14:30	18:21:00	18:32:30	18:49:00	19:07:00	19:08:30	19:11:30
17:05:30	17:08:30	17:10:30	17:28:00	17:44:30	17:56:00	18:05:00	-	-	18:18:30	18:25:00	18:36:30	18:53:00	19:11:00	19:12:30	19:15:30

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-4. Future Baseline (CBTC) Operating Plan – 4 Line – Woodlawn-Lexington Avenue Express – Utica

Woodlawn	Bedford Pk Blvd	Kingsbridge Rd	125 Street	Brooklyn Bridge	Atlantic Avenue	Crown Heights - Utica Avenue	New Lots Avenue	New Lots Avenue	Crown Heights - Utica Avenue	Atlantic Avenue	Brooklyn Bridge	125 Street	Kingsbridge Rd	Bedford Pk Blvd	Woodlawn
17:07:30	17:10:30	17:12:30	17:30:00	17:46:30	17:58:00	18:07:00	-	-	18:23:00	18:29:30	18:41:00	18:57:30	19:15:30	19:17:00	19:20:00
17:13:30	17:16:30	17:18:30	17:36:00	17:52:30	18:04:00	18:13:00	-	-	18:26:30	18:33:00	18:44:30	19:01:00	19:16:30	19:18:00	19:21:00
17:19:30	17:22:30	17:24:30	17:42:00	17:58:30	18:10:00	18:19:00	-	-	18:32:30	18:39:00	18:50:30	19:07:00	19:25:00	19:26:30	19:29:30
17:25:30	17:28:30	17:30:30	17:48:00	18:04:30	18:16:00	18:25:00	-	-	18:38:30	18:45:00	18:56:30	19:13:00	19:31:00	19:32:30	19:35:30
17:29:30	17:32:30	17:34:30	17:52:00	18:08:30	18:20:00	18:29:00	-	-	18:44:30	18:51:00	19:02:30	19:19:00	19:37:00	19:38:30	19:41:30
17:39:00	17:42:00	17:43:30	18:01:00	18:17:30	18:29:00	18:37:30	-	-	18:48:30	18:55:00	19:06:30	19:23:00	19:41:00	19:42:30	19:45:30
17:43:30	17:46:30	17:48:00	18:05:30	18:22:00	18:33:30	18:42:00	-	-	18:56:30	19:03:00	19:14:30	19:31:00	19:46:30	19:48:00	19:51:00
17:49:30	17:52:30	17:54:00	18:11:30	18:28:00	18:39:30	18:48:00	-	-	19:00:30	19:07:00	19:18:00	19:34:00	19:51:30	19:53:00	19:56:00
17:57:00	18:00:00	18:01:30	18:19:00	18:35:30	18:47:00	18:55:30	-	-	19:08:00	19:14:30	19:25:30	19:41:30	19:59:00	20:00:30	20:03:30
18:05:00	18:08:00	18:09:30	18:27:00	18:43:30	18:55:00	19:03:30	-	-	19:19:00	19:25:30	19:36:30	19:52:30	20:07:30	20:09:00	20:12:00
18:08:00	18:11:00	18:12:30	18:30:00	18:46:30	18:58:00	19:06:30	-	-	19:23:00	19:29:30	19:40:30	19:56:30	20:14:00	20:15:30	20:18:30
18:15:00	18:18:00	18:19:30	18:37:00	18:53:30	19:05:00	19:13:30	-	-	19:31:00	19:37:30	19:48:30	20:04:30	20:22:00	20:23:30	20:26:30
18:25:30	18:28:30	18:30:00	18:47:30	19:04:00	19:15:30	19:24:00	-	-	19:37:00	19:43:30	19:54:30	20:10:30	20:28:00	20:29:30	20:32:30
18:31:30	18:34:30	18:36:00	18:53:30	19:10:00	19:21:30	19:30:00	-	-	19:41:00	19:47:30	19:58:30	20:14:30	20:29:30	20:31:00	20:34:00
18:38:30	18:41:30	18:43:00	19:00:30	19:17:00	19:28:00	19:36:00	-	-	19:49:00	19:55:30	20:06:30	20:22:30	20:40:00	20:41:30	20:44:30
18:44:30	18:47:30	18:49:00	19:06:30	19:23:00	19:34:00	19:42:00	-	-	19:55:00	20:01:30	20:12:30	20:28:30	20:46:00	20:47:30	20:50:30
18:50:30	18:53:30	18:55:00	19:12:30	19:29:00	19:40:00	19:48:00	-	-	20:01:00	20:07:30	20:18:30	20:34:30	20:52:00	20:53:30	20:56:30
18:56:30	18:59:30	19:01:00	19:18:30	19:35:00	19:46:00	19:54:00	-	-	20:07:00	20:13:30	20:24:30	20:40:30	20:58:00	20:59:30	21:02:30
19:02:30	19:05:30	19:07:00	19:24:30	19:41:00	19:52:00	20:00:00	-	-	20:13:00	20:19:30	20:30:30	20:46:30	21:04:00	21:05:30	21:08:30
19:08:30	19:11:30	19:13:00	19:30:30	19:47:00	19:58:00	20:06:00	-	-	20:17:00	20:23:30	20:34:30	20:50:30	21:08:00	21:09:30	21:12:30
19:14:30	19:17:30	19:19:00	19:36:30	19:53:00	20:04:00	20:12:00	-	-	20:25:00	20:31:30	20:42:30	20:58:30	21:16:00	21:17:30	21:20:30
19:20:30	19:23:30	19:25:00	19:42:30	19:59:00	20:10:00	20:18:00	-	-	20:35:00	20:41:30	20:52:30	21:08:30	21:26:00	21:27:30	21:30:30
19:26:30	19:29:30	19:31:00	19:48:30	20:05:00	20:16:00	20:24:00	-	-	20:37:00	20:43:30	20:54:30	21:10:30	21:28:00	21:29:30	21:32:30
19:32:30	19:35:30	19:37:00	19:54:30	20:11:00	20:22:00	20:30:00	-	-	20:45:00	20:51:30	21:02:30	21:18:30	21:36:00	21:37:30	21:40:30
19:38:30	19:41:30	19:43:00	20:00:30	20:17:00	20:28:00	20:36:00	-	-	20:53:00	20:59:30	21:10:30	21:26:30	21:44:00	21:45:30	21:48:30
19:44:30	19:47:30	19:49:00	20:06:30	20:23:00	20:34:00	20:42:00	-	-	20:57:00	21:03:30	21:14:30	21:30:30	21:48:00	21:49:30	21:52:30
19:50:30	19:53:30	19:55:00	20:12:30	20:29:00	20:40:00	20:48:00	-	-	21:03:00	21:09:30	21:20:30	21:36:30	21:54:00	21:55:30	21:58:30
19:58:30	20:01:30	20:03:00	20:20:30	20:37:00	20:48:00	20:56:00	-	-	21:11:00	21:17:30	21:28:30	21:44:30	22:02:00	22:03:30	22:06:30
20:06:30	20:09:30	20:11:00	20:28:30	20:45:00	20:56:00	21:04:00	-	-	21:16:00	21:22:30	21:33:30	21:49:30	22:07:00	22:08:30	22:11:30
20:08:30	20:11:30	20:13:00	20:30:30	20:47:00	20:58:00	21:06:00	-	-	21:23:00	21:29:30	21:40:30	21:56:30	22:14:00	22:15:30	22:18:30
20:20:30	20:23:30	20:25:00	20:42:30	20:59:00	21:10:00	21:18:00	-	-	21:35:00	21:41:30	21:52:30	22:08:30	22:26:00	22:27:30	22:30:30
20:32:30	20:35:30	20:37:00	20:54:30	21:11:00	21:22:00	21:30:00	-	-	21:45:00	21:51:30	22:02:30	22:18:30	22:36:00	22:37:30	22:40:30
20:38:30	20:41:30	20:43:00	21:00:30	21:17:00	21:28:00	21:36:00	-	-	21:55:00	22:01:30	22:12:30	22:28:30	22:46:00	22:47:30	22:50:30
20:44:30	20:47:30	20:49:00	21:06:30	21:23:00	21:34:00	21:42:00	21:52:30								
20:50:30	20:53:30	20:55:00	21:12:30	21:29:00	21:40:00	21:50:30	-	-	22:05:00	22:11:30	22:22:30	22:38:30	22:56:00	22:57:30	23:00:30
21:02:30	21:05:30	21:07:00	21:24:30	21:41:00	21:52:00	22:02:30	-	-	22:13:30	22:20:00	22:31:00	22:47:00	23:04:30	23:06:00	23:09:00

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-4. Future Baseline (CBTC) Operating Plan – 4 Line – Woodlawn-Lexington Avenue Express – Utica

Woodlawn	Bedford Pk Blvd	Kingsbridge Rd	125 Street	Brooklyn Bridge	Atlantic Avenue	Crown Heights - Utica Avenue	New Lots Avenue	New Lots Avenue	Crown Heights - Utica Avenue	Atlantic Avenue	Brooklyn Bridge	125 Street	Kingsbridge Rd	Bedford Pk Blvd	Woodlawn
21:14:30	21:17:30	21:19:00	21:36:30	21:53:00	22:04:00	22:14:30	-	-	22:25:30	22:32:00	22:43:00	22:59:00	23:16:30	23:18:00	23:21:00
21:19:30	21:22:30	21:24:00	21:41:30	21:58:00	22:09:00	22:19:30	-	-	22:35:30	22:42:00	22:53:00	23:09:00	23:26:30	23:28:00	23:31:00
21:32:30	21:35:30	21:37:00	21:54:30	22:11:00	22:22:00	22:32:30	-	-	22:43:30	22:50:00	23:01:00	23:17:00	23:34:30	23:36:00	23:39:00
21:44:30	21:47:30	21:49:00	22:06:30	22:23:00	22:34:00	22:44:30	-	-	22:55:30	23:02:00	23:13:00	23:29:00	23:46:30	23:48:00	23:51:00
21:50:30	21:53:30	21:55:00	22:12:30	22:29:00	22:40:00	22:50:30	23:01:00								
21:58:30	22:01:30	22:03:00	22:20:30	22:37:00	22:48:00	22:58:30	-	-	23:05:30	23:12:00	23:23:00	23:39:00	23:56:30	23:58:00	24:01:00
22:06:30	22:09:30	22:11:00	22:28:30	22:45:00	22:56:00	23:06:30	-	-	23:17:30	23:24:00	23:35:00	23:51:00	24:08:30	24:10:00	24:13:00
22:14:30	22:17:30	22:19:00	22:36:30	22:53:00	23:04:00	23:14:30	-	-	23:29:30	23:36:00	23:47:00	24:03:00	24:20:30	24:22:00	24:25:00
								23:30:00	23:39:30	23:49:00	24:00:00	24:16:00	24:33:30	24:35:00	24:38:00
22:22:30	22:25:30	22:27:00	22:44:30	23:01:00	23:12:00	23:22:30	23:33:00	23:45:00	23:54:30	24:04:00	24:15:00	24:31:00	24:48:30	24:50:00	24:53:00
22:34:30	22:37:30	22:39:00	22:56:30	23:13:00	23:24:00	23:34:30	23:45:00	23:59:00	24:08:30	24:18:00	24:29:00	24:45:00	25:02:30	25:04:00	25:07:00
22:46:30	22:49:30	22:51:00	23:08:30	23:25:00	23:36:00	23:46:30	23:57:00	24:08:00	24:17:30	24:27:00	24:38:00	24:54:00	25:11:30	25:13:00	25:16:00
23:02:30	23:05:30	23:07:00	23:24:30	23:41:00	23:52:00	24:02:30	24:13:00	24:25:00	24:34:30	24:44:00	24:55:00	25:11:00	25:28:30	25:30:00	25:33:00
23:14:30	23:17:30	23:19:00	23:36:30	23:53:00	24:04:00	24:14:30	24:25:00	24:42:00	24:51:30	25:01:00	25:12:00	25:28:00	25:45:30	25:47:00	25:50:00
23:26:30	23:29:30	23:31:00	23:48:30	24:05:00	24:16:00	24:26:30	24:37:00	24:52:00	25:01:30	25:11:00	25:22:00	25:49:00	26:06:30	26:08:00	26:11:00
23:40:30	23:43:30	23:45:00	24:02:30	24:19:00	24:30:00	24:40:30	24:51:00	25:12:00	25:21:30	25:31:00	25:42:00	26:09:00	26:26:30	26:28:00	26:31:00
23:58:30	24:01:30	24:03:00	24:20:30	24:37:00	24:48:00	24:58:30	25:09:00	25:32:00	25:41:30	25:51:00	26:02:00	26:29:00	26:46:30	26:48:00	26:51:00
24:14:00	24:17:00	24:18:30	24:36:00	24:52:30	25:03:30	25:14:00	25:24:30								
24:23:00	24:26:00	24:27:30	24:45:00	25:13:30	25:24:30	25:35:00	25:45:30								
24:43:00	24:46:00	24:47:30	25:05:00	25:33:30	25:44:30	25:55:00	26:05:30								
25:03:00	25:06:00	25:07:30	25:25:00	25:53:30	26:04:30	26:15:00	26:25:30								
25:23:00	25:26:00	25:27:30	25:45:00	26:13:30	26:24:30	26:35:00	26:45:30								
25:43:00	25:46:00	25:47:30	26:05:00	26:33:30	26:44:30	26:55:00	27:05:30								

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

G.2.5 5 Line Operating Plan

Table G.2-5. Future Baseline (CBTC) Operating Plan - 5 Line - Lexington Avenue Express - Flatbush

Nereid Avenue	Eastchester-Dyre Avenue	E 180 Street	125 Street	Bowling Green	Atlantic Avenue	Flatbush Avenue - Brooklyn College	New Lots Avenue	New Lots Avenue	Flatbush Avenue - Brooklyn College	Atlantic Avenue	Bowling Green	125 Street	E 180 Street	Eastchester-Dyre Avenue	Nereid Avenue
-	0:03:00	0:13:00	-	-	-	-	-	-	-	-	-	-	0:23:00	0:34:00	-
-	0:23:00	0:33:00	-	-	-	-	-	-	-	-	-	-	0:43:00	0:54:00	-
-	0:43:00	0:53:00	-	-	-	-	-	-	-	-	-	-	1:03:00	1:14:00	-
-	1:03:00	1:13:00	-	-	-	-	-	-	-	-	-	-	1:23:00	1:34:00	-
-	1:23:00	1:33:00	-	-	-	-	-	-	-	-	-	-	1:43:00	1:54:00	-
-	1:43:00	1:53:00	-	-	-	-	-	-	-	-	-	-	2:03:00	2:14:00	-
-	2:03:00	2:13:00	-	-	-	-	-	-	-	-	-	-	2:23:00	2:34:00	-
-	2:23:00	2:33:00	-	-	-	-	-	-	-	-	-	-	2:43:00	2:54:00	-
-	2:43:00	2:53:00	-	-	-	-	-	-	-	-	-	-	3:03:00	3:14:00	-
-	3:03:00	3:13:00	-	-	-	-	-	-	-	-	-	-	3:23:00	3:34:00	-
-	3:23:00	3:33:00	-	-	-	-	-	-	-	-	-	-	3:43:00	3:54:00	-
-	3:43:00	3:53:00	-	-	-	-	-	-	-	-	-	-	4:03:00	4:14:00	-
-	4:03:00	4:13:00	-	-	-	-	-	-	-	-	-	-	4:23:00	4:34:00	-
-	4:23:00	4:33:00	-	-	-	-	-	-	-	-	-	-	4:43:00	4:54:00	-
-	4:43:00	4:53:00	-	-	-	-	-	-	-	-	-	-	5:03:00	5:14:00	-
-	5:03:00	5:13:00	-	-	-	-	-	-	-	-	-	-	5:23:00	5:34:00	-
								-	-	-	-	-	5:43:00	5:54:00	-
								-	-	-	-	-	6:03:00	6:14:00	-
								-	-	-	-	-	6:23:00	6:34:00	-
								-	-	-	-	-	6:36:00	6:47:00	-
							5:44:00	-	6:03:00	6:10:00	6:30:00	6:49:30	7:00:30	7:14:00	-
-	-	-	-	-	5:40:00	5:55:00	-	-	6:02:00	6:16:30	6:23:30	6:43:30	7:03:00	7:14:00	-
-	-	-	-	-	5:51:00	6:06:00	-	-	6:08:00	6:24:00	6:31:00	6:51:00	7:11:00	7:22:00	-
-	5:06:00	5:16:00	5:34:30	5:55:00	6:02:30	6:17:30	-	-	6:20:00	6:36:00	6:43:00	7:03:00	7:23:00	7:34:00	-
-	5:18:00	5:28:00	5:46:30	6:07:00	6:14:30	6:29:30	-	-	6:32:00	6:48:00	6:55:00	7:15:00	7:35:00	7:46:00	-
-	5:30:00	5:40:00	5:58:30	6:19:00	6:26:30	6:41:30	-	-	6:44:30	7:00:30	7:07:30	7:27:30	7:47:30	7:58:30	-
-	5:33:30	5:44:00	6:03:00	6:23:30	6:31:00	6:47:30	-	-	6:50:00	7:06:00	7:13:00	7:33:00	7:53:00	8:04:00	-
-	5:45:30	5:56:00	6:15:00	6:35:30	6:43:00	6:59:30	-	-	7:02:00	7:18:00	7:25:00	7:46:00	8:07:30	8:18:30	-
-	5:51:30	6:02:00	6:21:00	6:41:30	6:49:00	7:05:30	-	-	7:08:00	7:24:00	7:31:00	7:52:00	8:13:30	8:24:30	-
							7:22:30	-	7:36:00	7:43:00	8:04:00	8:25:30	8:36:30	8:48:30	-
-	6:09:00	6:19:30	6:32:00	6:52:30	7:00:00	-	7:19:00	7:26:00	-	7:39:30	7:46:30	8:07:30	8:29:00	8:40:00	-
-	6:16:00	6:26:30	6:39:00	6:59:30	7:07:00	7:23:30	-	-	7:26:00	7:42:00	7:49:00	8:10:00	8:31:30	8:42:30	-
-	6:20:00	6:30:30	6:43:00	7:03:30	7:11:00	-	7:30:00	7:50:00	-	8:03:30	8:10:30	8:31:30	8:53:00	9:04:00	-
6:17:30	-	6:32:30	6:45:00	7:05:30	7:13:00	7:29:30	-	-	7:32:00	7:48:00	7:55:00	8:16:00	8:37:30	8:48:30	-

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-5. Future Baseline (CBTC) Operating Plan - 5 Line - Lexington Avenue Express - Flatbush

Nereid Avenue	Eastchester-Dyre Avenue	E 180 Street	125 Street	Bowling Green	Atlantic Avenue	Flatbush Avenue - Brooklyn College	New Lots Avenue	New Lots Avenue	Flatbush Avenue - Brooklyn College	Atlantic Avenue	Bowling Green	125 Street	E 180 Street	Eastchester-Dyre Avenue	Nereid Avenue
-	6:34:30	6:45:00	6:57:30	7:18:00	7:25:30	7:42:00	-	-	7:44:00	8:00:00	8:07:00	8:28:00	8:49:30	9:00:30	-
6:34:30	-	6:49:30	7:02:00	7:23:00	7:31:00	7:47:30	-	-	7:50:00	8:06:00	8:13:00	8:34:00	8:55:30	9:06:30	-
-	6:44:30	6:55:30	7:08:00	7:28:30	7:36:00	-	7:55:00	8:10:00	-	8:23:30	8:30:30	8:51:30	9:13:00	9:24:00	-
-	6:50:30	7:01:00	7:13:30	7:34:00	7:41:30	7:58:00	-	-	8:02:00	8:18:00	8:25:00	8:46:00	9:07:30	9:18:30	-
6:52:30	-	7:07:30	7:20:00	7:41:00	7:49:00	8:05:30	-	-	8:08:00	8:24:00	8:31:00	8:52:00	9:13:30	9:24:30	-
-	7:01:30	7:12:30	7:25:00	7:45:30	7:53:00	-	8:12:00	8:35:00	-	8:48:30	8:55:30	9:16:30	9:38:00	9:49:00	-
-	7:08:30	7:19:30	7:32:00	7:53:00	8:01:00	8:17:30	-	-	8:20:00	8:36:00	8:43:00	9:04:00	9:25:30	9:36:30	-
7:10:30	-	7:25:30	7:38:00	7:59:00	8:07:00	8:23:30	-	-	8:26:00	8:42:00	8:49:00	9:10:00	9:31:30	9:42:30	-
-	7:20:30	7:31:30	7:44:00	8:05:00	8:13:00	8:29:30	-	-	8:32:00	8:48:00	8:55:00	9:16:00	9:37:30	9:48:30	-
-	7:25:30	7:36:30	7:49:00	8:09:30	8:17:00	-	8:36:00	8:44:00	-	8:57:30	9:04:30	9:25:30	9:47:00	9:58:00	-
7:28:30	-	7:43:30	7:56:00	8:17:00	8:25:00	8:41:30	-	-	8:50:00	9:06:00	9:13:00	9:34:00	9:55:30	10:06:30	-
-	7:38:30	7:49:30	8:02:00	8:22:30	8:30:00	-	8:49:00	9:06:00	-	9:19:30	9:26:30	9:47:30	10:09:00	10:20:00	-
7:46:30	-	8:01:30	8:14:00	8:35:00	8:43:00	8:59:30	-	-	9:02:00	9:18:00	9:25:00	9:45:00	10:05:00	10:16:00	-
-	7:56:30	8:07:30	8:20:00	8:41:00	8:49:00	9:05:30	-	-	9:08:00	9:24:00	9:31:00	9:51:00	10:11:00	10:22:00	-
-	8:01:30	8:12:30	8:25:00	8:45:30	8:53:00	-	9:12:00								
8:04:30	-	8:19:30	8:32:00	8:53:00	9:01:00	9:17:30	-	-	9:20:00	9:36:00	9:43:00	10:03:00	10:23:00	10:34:00	-
-	8:14:30	8:25:30	8:38:00	8:59:00	9:07:00	9:23:30	-	-	9:26:00	9:42:00	9:49:00	10:09:00	10:29:00	10:40:00	-
8:16:30	-	8:31:30	8:44:00	9:05:00	9:13:00	9:29:30	-	-	9:32:00	9:48:00	9:55:00	10:15:00	10:35:00	10:46:00	-
-	8:25:30	8:36:30	8:49:00	9:09:30	9:17:00	-	9:36:00								
-	8:32:30	8:43:30	8:56:00	9:17:00	9:25:00	9:41:30	-	-	9:44:00	10:00:00	10:07:00	10:27:00	10:47:00	10:58:00	-
-	8:40:30	8:51:00	9:03:00	9:23:30	9:31:00	9:47:30	-	-	9:50:00	10:06:00	10:13:00	10:33:00	10:53:00	11:04:00	-
-	8:52:30	9:03:00	9:15:00	9:35:30	9:43:00	9:59:30	-	-	10:02:00	10:16:30	10:23:30	10:43:30	11:03:00	11:14:00	-
-	8:58:30	9:09:00	9:21:00	9:41:30	9:49:00	10:05:30	-	-	10:08:00	10:22:30	10:29:30	10:49:30	11:09:00	11:20:00	-
-	9:03:30	9:14:00	9:33:00	9:53:30	10:01:00	10:17:30	-	-	10:20:00	10:34:30	10:41:30	11:01:30	11:21:00	11:32:00	-
-	9:09:30	9:20:00	9:39:00	9:59:30	10:07:00	10:23:30	-	-	10:26:00	10:40:30	10:47:30	11:07:30	11:27:00	11:38:00	-
-	9:15:30	9:26:00	9:45:00	10:05:30	10:13:00	10:29:30	-	-	10:32:00	10:46:30	10:53:30	11:13:30	11:33:00	11:44:00	-
-	9:27:30	9:38:00	9:57:00	10:17:30	10:25:00	10:41:30	-	-	10:44:00	10:58:30	11:05:30	11:25:30	11:45:00	11:56:00	-
-	9:36:00	9:46:00	10:04:30	10:25:00	10:32:30	10:47:30	-	-	10:50:00	11:04:30	11:11:30	11:31:30	11:51:00	12:02:00	-
-	9:48:00	9:58:00	10:16:30	10:37:00	10:44:30	10:59:30	-	-	11:02:00	11:16:30	11:23:30	11:43:30	12:03:00	12:14:00	-
-	9:54:00	10:04:00	10:22:30	10:43:00	10:50:30	11:05:30	-	-	11:08:00	11:22:30	11:29:30	11:49:30	12:09:00	12:20:00	-
-	10:06:00	10:16:00	10:34:30	10:55:00	11:02:30	11:17:30	-	-	11:20:00	11:34:30	11:41:30	12:01:30	12:21:00	12:32:00	-
-	10:12:00	10:22:00	10:40:30	11:01:00	11:08:30	11:23:30	-	-	11:26:00	11:40:30	11:47:30	12:07:30	12:27:00	12:38:00	-
-	10:18:00	10:28:00	10:46:30	11:07:00	11:14:30	11:29:30	-	-	11:32:00	11:46:30	11:53:30	12:13:30	12:33:00	12:44:00	-
-	10:30:00	10:40:00	10:58:30	11:19:00	11:26:30	11:41:30	-	-	11:44:00	11:58:30	12:05:30	12:25:30	12:45:00	12:56:00	-
-	10:36:00	10:46:00	11:04:30	11:25:00	11:32:30	11:47:30	-	-	11:50:00	12:04:30	12:11:30	12:31:30	12:51:00	13:02:00	-
-	10:48:00	10:58:00	11:16:30	11:37:00	11:44:30	11:59:30	-	-	12:02:00	12:16:30	12:23:30	12:43:30	13:03:00	13:14:00	-

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-5. Future Baseline (CBTC) Operating Plan - 5 Line - Lexington Avenue Express - Flatbush

Nereid Avenue	Eastchester-Dyre Avenue	E 180 Street	125 Street	Bowling Green	Atlantic Avenue	Flatbush Avenue - Brooklyn College	New Lots Avenue	New Lots Avenue	Flatbush Avenue - Brooklyn College	Atlantic Avenue	Bowling Green	125 Street	E 180 Street	Eastchester-Dyre Avenue	Nereid Avenue
-	10:54:00	11:04:00	11:22:30	11:43:00	11:50:30	12:05:30	-	-	12:08:00	12:22:30	12:29:30	12:49:30	13:09:00	13:20:00	-
-	11:06:00	11:16:00	11:34:30	11:55:00	12:02:30	12:17:30	-	-	12:20:00	12:34:30	12:41:30	13:01:30	13:21:00	13:32:00	-
-	11:12:00	11:22:00	11:40:30	12:01:00	12:08:30	12:23:30	-	-	12:26:00	12:40:30	12:47:30	13:07:30	13:27:00	13:38:00	-
-	11:18:00	11:28:00	11:46:30	12:07:00	12:14:30	12:29:30	-	-	12:32:00	12:46:30	12:53:30	13:13:30	13:33:00	13:44:00	-
-	11:30:00	11:40:00	11:58:30	12:19:00	12:26:30	12:41:30	-	-	12:44:00	12:58:30	13:05:30	13:25:30	13:45:00	13:56:00	-
-	11:36:00	11:46:00	12:04:30	12:25:00	12:32:30	12:47:30	-	-	12:50:00	13:04:30	13:11:30	13:31:30	13:51:00	14:02:00	-
-	11:48:00	11:58:00	12:16:30	12:37:00	12:44:30	12:59:30	-	-	13:02:00	13:16:30	13:23:30	13:43:30	14:03:00	14:14:00	-
-	11:54:00	12:04:00	12:22:30	12:43:00	12:50:30	13:05:30	-	-	13:08:00	13:22:30	13:29:30	13:49:30	14:09:00	14:20:00	-
-	12:06:00	12:16:00	12:34:30	12:55:00	13:02:30	13:17:30	-	-	13:20:00	13:34:30	13:41:30	14:01:30	14:21:00	14:32:00	-
-	12:12:00	12:22:00	12:40:30	13:01:00	13:08:30	13:23:30	-	-	13:26:00	13:40:30	13:47:30	14:07:30	14:27:00	14:38:00	-
-	12:18:00	12:28:00	12:46:30	13:07:00	13:14:30	13:29:30	-	-	13:32:00	13:46:30	13:53:30	14:13:30	14:33:00	14:44:00	-
-	12:30:00	12:40:00	12:58:30	13:19:00	13:26:30	13:41:30	-	-	13:44:00	13:58:30	14:05:30	14:25:30	14:45:00	14:56:00	-
-	12:36:00	12:46:00	13:04:30	13:25:00	13:32:30	13:47:30	-	-	13:50:00	14:04:30	14:11:30	14:31:30	14:51:00	15:02:00	-
-	12:48:00	12:58:00	13:16:30	13:37:00	13:44:30	13:59:30	-	-	14:02:00	14:16:30	14:23:30	14:43:30	15:03:00	15:14:00	-
-	12:54:00	13:04:00	13:22:30	13:43:00	13:50:30	14:05:30	-	-	14:08:00	14:22:30	14:29:30	14:49:30	15:09:00	15:20:00	-
-	13:06:00	13:16:00	13:34:30	13:55:00	14:02:30	14:17:30	-	-	14:20:00	14:34:30	14:41:30	15:01:30	15:21:00	15:32:00	-
-	13:12:00	13:22:00	13:40:30	14:01:00	14:08:30	14:23:30	-	-	14:26:00	14:40:30	14:47:30	15:07:30	15:27:00	15:38:00	-
-	13:18:00	13:28:00	13:46:30	14:07:00	14:14:30	14:29:30	-	-	14:32:00	14:46:30	14:53:30	15:13:30	15:33:00	15:44:00	-
-	13:30:00	13:40:00	13:58:30	14:19:00	14:26:30	14:41:30	-	-	14:44:00	14:58:30	15:05:30	15:25:30	15:45:00	15:56:00	-
-	13:36:00	13:46:00	14:04:30	14:25:00	14:32:30	14:47:30	-	-	14:50:00	15:04:30	15:11:30	15:31:30	15:51:00	16:02:00	-
-	13:48:00	13:58:00	14:16:30	14:37:00	14:44:30	14:59:30	-	-	15:02:00	15:16:30	15:23:30	15:43:30	16:03:00	16:14:00	-
-	13:54:00	14:04:00	14:22:30	14:43:00	14:50:30	15:05:30	-	-	15:08:00	15:24:00	15:31:00	15:51:00	16:11:00	16:22:00	-
-	14:06:00	14:16:00	14:34:30	14:55:00	15:02:30	15:17:30	-	-	15:20:00	15:36:00	15:43:00	16:03:00	16:23:00	16:34:00	-
-	14:12:00	14:22:00	14:40:30	15:01:00	15:08:30	15:23:30	-	-	15:26:00	15:42:00	15:49:00	16:09:00	16:29:00	16:40:00	-
-	14:18:00	14:28:00	14:46:30	15:07:00	15:14:30	15:29:30	-	-	15:32:00	15:48:00	15:55:00	16:15:00	16:35:00	16:46:00	-
-	14:30:00	14:40:00	14:58:30	15:19:00	15:26:30	15:41:30	-	-	15:44:00	16:00:00	16:07:00	16:27:00	16:41:30	16:52:30	-
-	14:33:30	14:44:00	15:03:00	15:23:30	15:31:00	15:47:30	-	-	15:50:00	16:06:00	16:13:00	16:33:00	16:47:30	16:58:30	-
-	14:45:30	14:56:00	15:15:00	15:35:30	15:43:00	15:59:30	-	-	16:02:00	16:18:00	16:25:00	16:46:00	17:01:00	-	17:17:30
-	14:51:30	15:02:00	15:21:00	15:41:30	15:49:00	16:05:30	-	-	16:08:00	16:24:00	16:31:00	16:52:00	17:07:00	17:18:00	-
-	15:03:30	15:14:00	15:33:00	15:53:30	16:01:00	16:17:30	-	-	16:20:00	16:36:00	16:43:00	17:04:00	17:19:00	-	17:35:30
-	15:09:30	15:20:00	15:39:00	15:59:30	16:07:00	16:23:30	-	-	16:26:00	16:42:00	16:49:00	17:10:00	17:25:00	17:36:00	-
-	15:15:30	15:26:00	15:45:00	16:05:30	16:13:00	16:29:30	-	-	16:32:00	16:48:00	16:55:00	17:16:00	17:31:00	-	17:47:30
-	15:28:30	15:39:00	15:58:00	16:18:30	16:26:00	16:42:00	-	-	16:44:00	17:00:00	17:07:00	17:28:00	17:43:00	17:54:00	-
-	15:32:00	15:43:00	16:02:00	16:23:00	16:31:00	16:47:30	-	16:48:00	-	17:08:00	17:15:00	17:36:00	17:51:00	18:02:00	-
-	15:38:00	15:49:00	16:08:00	16:29:00	16:37:00	-	16:56:30	17:10:00	-	17:06:00	17:13:00	17:34:00	17:49:00	-	18:05:30
-	15:38:00	15:49:00	16:08:00	16:29:00	16:37:00	-	16:56:30	17:10:00	-	17:30:00	17:37:00	17:58:00	18:13:00	18:24:00	-

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-5. Future Baseline (CBTC) Operating Plan - 5 Line - Lexington Avenue Express - Flatbush

Nereid Avenue	Eastchester-Dyre Avenue	E 180 Street	125 Street	Bowling Green	Atlantic Avenue	Flatbush Avenue - Brooklyn College	New Lots Avenue	New Lots Avenue	Flatbush Avenue - Brooklyn College	Atlantic Avenue	Bowling Green	125 Street	E 180 Street	Eastchester-Dyre Avenue	Nereid Avenue
-	15:44:00	15:55:00	16:14:00	16:35:00	16:43:00	16:59:30	-	-	17:02:00	17:18:00	17:25:00	17:46:00	18:01:00	18:12:00	-
-	15:50:00	16:01:00	16:20:00	16:41:00	16:49:00	17:05:30	-	-	17:08:00	17:24:00	17:31:00	17:52:00	18:07:00	-	18:23:30
-	15:52:00	16:03:00	16:22:00	16:43:00	16:51:00	-	17:10:30	17:36:00	-	17:56:00	18:03:00	18:24:00	18:39:00	18:50:00	-
-	16:02:00	16:13:00	16:32:00	16:53:00	17:01:00	17:17:30	-	-	17:20:00	17:36:00	17:43:00	18:04:00	18:19:00	18:30:00	-
-	16:08:00	16:19:00	16:38:00	16:59:00	17:07:00	17:23:30	-	-	17:26:00	17:42:00	17:49:00	18:10:00	18:25:00	-	18:41:30
-	16:14:00	16:25:00	16:44:00	17:05:00	17:13:00	17:29:30	-	-	17:32:00	17:48:00	17:55:00	18:16:00	18:31:00	18:42:00	-
-	16:20:00	16:31:00	16:50:00	17:11:00	17:19:00	-	17:38:30	17:50:00	-	18:10:00	18:17:00	18:38:00	18:53:00	19:04:00	-
-	16:26:00	16:37:00	16:56:00	17:17:00	17:25:00	17:41:30	-	-	17:44:00	18:00:00	18:07:00	18:28:00	18:43:00	-	18:59:30
-	16:32:00	16:43:00	17:02:00	17:23:00	17:31:00	17:47:30	-	-	17:50:00	18:06:00	18:13:00	18:34:00	18:49:00	19:00:00	-
-	16:36:00	16:47:00	17:06:00	17:27:00	17:35:00	-	17:54:30	18:15:00	-	18:35:00	18:42:00	19:03:00	19:18:00	19:29:00	-
-	16:44:00	16:55:00	17:14:00	17:35:00	17:43:00	17:59:30	-	-	18:02:00	18:18:00	18:25:00	18:46:00	19:01:00	-	19:17:30
-	16:50:00	17:01:00	17:20:00	17:41:00	17:49:00	18:05:30	-	-	18:08:00	18:24:00	18:31:00	18:52:00	19:07:00	19:18:00	-
-	17:02:00	17:13:00	17:32:00	17:53:00	18:01:00	18:17:30	-	-	18:20:00	18:36:00	18:43:00	19:03:00	19:17:30	19:28:30	-
-	17:02:00	17:13:00	17:32:00	17:53:00	18:01:00	-	18:20:30	18:33:00	-	18:53:00	19:00:00	19:21:00	19:36:00	19:47:00	-
-	17:08:00	17:19:00	17:38:00	17:59:00	18:07:00	18:23:30	-	-	18:26:00	18:42:00	18:49:00	19:09:00	19:23:30	19:34:30	-
-	17:14:00	17:25:00	17:44:00	18:05:00	18:13:00	18:29:30	-	-	18:32:00	18:48:00	18:55:00	19:15:00	19:29:30	19:40:30	-
-	17:20:00	17:31:00	17:50:00	18:11:00	18:19:00	-	18:38:30	18:50:00	-	19:10:00	19:17:00	19:38:00	19:53:00	20:04:00	-
-	17:26:00	17:37:00	17:56:00	18:17:00	18:25:00	18:41:30	-	-	18:44:00	19:00:00	19:07:00	19:27:00	19:41:30	19:52:30	-
-	17:33:30	17:44:00	18:03:00	18:23:30	18:31:00	18:47:30	-	-	18:50:00	19:06:00	19:13:00	19:33:00	19:47:30	19:58:30	-
-	17:39:00	17:50:00	18:09:00	18:30:00	18:38:00	-	18:57:30								
-	17:45:30	17:56:00	18:15:00	18:35:30	18:43:00	18:59:30	-	-	19:02:00	19:16:30	19:23:30	19:43:30	19:58:00	20:09:00	-
-	17:51:30	18:02:00	18:21:00	18:41:30	18:49:00	19:05:30	-	-	19:08:00	19:22:30	19:29:30	19:49:30	20:04:00	20:15:00	-
-	18:03:30	18:14:00	18:33:00	18:53:30	19:01:00	19:17:30	-	-	19:20:00	19:34:30	19:41:30	20:01:30	20:21:00	20:32:00	-
-	18:09:30	18:20:00	18:39:00	18:59:30	19:07:00	19:23:30	-	-	19:26:00	19:40:30	19:47:30	20:07:30	20:27:00	20:38:00	-
-	18:15:30	18:26:00	18:45:00	19:05:30	19:13:00	19:29:30	-	-	19:32:00	19:46:30	19:53:30	20:13:30	20:33:00	20:44:00	-
-	18:27:30	18:38:00	18:57:00	19:17:30	19:25:00	19:41:30	-	-	19:44:00	19:58:30	20:05:30	20:25:30	20:45:00	20:56:00	-
-	18:35:30	18:45:30	19:04:00	19:24:30	19:32:00	19:47:00	-	-	19:50:00	20:04:30	20:11:30	20:31:30	20:51:00	21:02:00	-
-	18:47:30	18:57:30	19:16:00	19:36:30	19:44:00	19:59:00	-	-	20:02:00	20:16:30	20:23:30	20:43:30	21:03:00	21:14:00	-
-	18:53:30	19:03:30	19:22:00	19:42:30	19:50:00	20:05:00	-	-	20:08:00	20:22:30	20:29:30	20:49:30	21:09:00	21:20:00	-
-	19:04:30	19:14:30	19:33:00	19:53:30	20:01:00	20:16:00	-	-	20:26:00	20:40:30	20:47:30	21:07:30	21:27:00	21:38:00	-
-	19:10:30	19:20:30	19:39:00	19:59:30	20:07:00	20:22:00	-	-	20:32:00	20:46:30	20:53:30	21:13:30	21:33:00	21:44:00	-
-	19:16:30	19:26:30	19:45:00	20:05:30	20:13:00	-	20:32:00								
-	19:28:30	19:38:30	19:57:00	20:17:30	20:25:00	-	20:44:00								
-	19:34:30	19:44:30	20:03:00	20:23:30	20:31:00	-	20:50:00								
-	19:46:30	19:56:30	20:15:00	20:35:30	20:43:00	-	21:02:00								
-	20:04:30	20:14:30	20:33:00	20:53:30	-	-	-	-	-	21:02:00	21:22:00	21:41:30	21:52:30	-	-

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-5. Future Baseline (CBTC) Operating Plan - 5 Line - Lexington Avenue Express - Flatbush

Nereid Avenue	Eastchester-Dyre Avenue	E 180 Street	125 Street	Bowling Green	Atlantic Avenue	Flatbush Avenue - Brooklyn College	New Lots Avenue	New Lots Avenue	Flatbush Avenue - Brooklyn College	Atlantic Avenue	Bowling Green	125 Street	E 180 Street	Eastchester-Dyre Avenue	Nereid Avenue
-	20:16:30	20:26:30	20:45:00	21:05:30	-	-	-	-	-	-	21:14:00	21:34:00	21:53:30	22:04:30	-
-	20:28:30	20:38:30	20:57:00	21:17:30	-	-	-	-	-	-	21:24:00	21:44:00	22:03:30	22:14:30	-
-	20:34:30	20:44:30	21:03:00	21:23:30	-	-	-	-	-	-	21:33:00	21:53:00	22:12:30	22:23:30	-
-	20:46:30	20:56:30	21:15:00	21:35:30	-	-	-	-	-	-	21:44:00	22:04:00	22:23:30	22:34:30	-
-	21:04:30	21:14:30	21:33:00	21:53:30	-	-	-	-	-	-	22:02:00	22:22:00	22:41:30	22:52:30	-
-	21:16:30	21:26:30	21:45:00	22:05:30	-	-	-	-	-	-	22:14:00	22:34:00	22:53:30	23:04:30	-
-	21:28:30	21:38:30	21:57:00	22:17:30	-	-	-	-	-	-	22:26:00	22:46:00	23:05:30	23:16:30	-
-	21:34:30	21:44:30	22:03:00	22:23:30	-	-	-	-	-	-	22:32:00	22:52:00	23:11:30	23:22:30	-
-	21:46:30	21:56:30	22:15:00	22:35:30	-	-	-	-	-	-	22:44:00	23:04:00	23:23:30	23:34:30	-
-	22:06:30	22:16:30	22:35:00	22:55:30	-	-	-	-	-	-	23:02:00	23:22:00	23:41:30	23:52:30	-
-	22:18:30	22:28:30	22:47:00	23:07:30	-	-	-	-	-	-	23:14:00	23:34:00	23:53:30	24:04:30	-
-	22:30:30	22:40:30	22:59:00	23:19:30	-	-	-	-	-	-	23:26:00	23:46:00	24:05:30	24:16:30	-
-	22:45:30	22:55:30	-	-	-	-	-								
-	23:00:30	23:10:30	-	-	-	-	-								
-	23:15:30	23:25:30	-	-	-	-	-								
-	23:30:30	23:40:30	-	-	-	-	-								
-	23:45:30	23:55:30	-	-	-	-	-								
-	24:03:00	24:13:00	-	-	-	-	-	-	-	-	-	-	24:25:30	24:36:30	-
-	24:23:00	24:33:00	-	-	-	-	-	-	-	-	-	-	24:45:30	24:56:30	-
-	24:43:00	24:53:00	-	-	-	-	-	-	-	-	-	-	25:05:30	25:16:30	-
-	25:03:00	25:13:00	-	-	-	-	-	-	-	-	-	-	25:25:30	25:36:30	-
-	25:23:00	25:33:00	-	-	-	-	-	-	-	-	-	-	25:45:30	25:56:30	-
-	25:43:00	25:53:00	-	-	-	-	-	-	-	-	-	-	-	-	-
-	26:03:00	26:13:00	-	-	-	-	-	-	-	-	-	-	-	-	-

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

G.2.6 6 Line Operating Plan

Table G.2-6. Future Baseline (CBTC) Operating Plan – 6 Line – Pelham-Lexington Avenue Local

Pelham Bay Park	Parkchester	3 Avenue-138 Street	125 Street	86 Street	Grand Central - 42 Street	14 Street - Union Sq	Brooklyn Bridge	Brooklyn Bridge	14 Street - Union Sq	Grand Central - 42 Street	86 Street	125 Street	3 Avenue-138 Street	Parkchester	Pelham Bay Park
0:09:00	0:17:00	0:33:00	0:35:30	0:42:00	0:50:30	0:56:30	1:04:00	1:18:00	1:25:00	1:30:30	1:38:30	1:45:00	1:47:00	2:04:00	2:12:00
0:25:00	0:33:00	0:49:00	0:51:30	0:58:00	1:06:30	1:12:30	1:20:00	1:33:30	1:40:30	1:46:00	1:54:00	2:00:30	2:02:30	2:19:30	2:27:30
0:43:00	0:51:00	1:07:00	1:09:30	1:16:00	1:24:30	1:30:30	1:38:00	1:52:30	1:59:30	2:05:00	2:13:00	2:19:30	2:21:30	2:38:30	2:46:30
1:03:00	1:11:00	1:27:00	1:29:30	1:36:00	1:44:30	1:50:30	1:58:00	2:12:30	2:19:30	2:25:00	2:33:00	2:39:30	2:41:30	2:58:30	3:06:30
1:23:00	1:31:00	1:47:00	1:49:30	1:56:00	2:04:30	2:10:30	2:18:00	2:32:30	2:39:30	2:45:00	2:53:00	2:59:30	3:01:30	3:18:30	3:26:30
1:43:00	1:51:00	2:07:00	2:09:30	2:16:00	2:24:30	2:30:30	2:38:00	2:52:30	2:59:30	3:05:00	3:13:00	3:19:30	3:21:30	3:38:30	3:46:30
2:03:00	2:11:00	2:27:00	2:29:30	2:36:00	2:44:30	2:50:30	2:58:00	3:12:30	3:19:30	3:25:00	3:33:00	3:39:30	3:41:30	3:58:30	4:06:30
2:23:00	2:31:00	2:47:00	2:49:30	2:56:00	3:04:30	3:10:30	3:18:00	3:32:30	3:39:30	3:45:00	3:53:00	3:59:30	4:01:30	4:18:30	4:26:30
2:43:00	2:51:00	3:07:00	3:09:30	3:16:00	3:24:30	3:30:30	3:38:00	3:52:30	3:59:30	4:05:00	4:13:00	4:19:30	4:21:30	4:38:30	4:46:30
3:03:00	3:11:00	3:27:00	3:29:30	3:36:00	3:44:30	3:50:30	3:58:00	4:12:30	4:19:30	4:25:00	4:33:00	4:39:30	4:41:30	4:58:30	5:06:30
3:23:00	3:31:00	3:47:00	3:49:30	3:56:00	4:04:30	4:10:30	4:18:00	4:32:30	4:39:30	4:45:00	4:53:00	4:59:30	5:01:30	5:18:30	5:26:30
3:43:00	3:51:00	4:07:00	4:09:30	4:16:00	4:24:30	4:30:30	4:38:00	4:52:30	4:59:30	5:05:00	5:13:00	5:19:30	5:21:30	5:38:30	5:46:30
4:01:30	4:09:30	4:25:30	4:28:00	4:34:30	4:43:00	4:49:00	4:56:30	5:10:30	5:17:30	5:23:00	5:31:00	5:37:30	5:39:30	5:56:30	6:04:30
4:17:00	4:25:00	4:41:00	4:43:30	4:50:00	4:58:30	5:04:30	5:12:00	5:26:00	5:33:00	5:38:30	5:46:30	5:53:00	5:55:00	6:12:00	6:20:00
4:32:00	4:40:00	4:56:00	4:58:30	5:05:00	5:13:30	5:19:30	5:27:00	5:38:00	5:45:00	5:50:30	5:58:30	6:05:00	6:07:00	6:24:00	6:32:00
4:44:00	4:52:00	5:08:00	5:10:30	5:17:00	5:25:30	5:31:30	5:39:00	5:50:00	5:57:00	6:02:30	6:10:30	6:17:00	6:19:00	6:36:00	6:44:00
4:56:00	5:04:00	5:20:00	5:22:30	5:29:00	5:37:30	5:43:30	5:51:00	6:00:00	6:07:00	6:13:30	6:21:30	6:28:00	6:30:00	6:47:00	6:55:00
5:07:30	5:15:30	5:31:30	5:34:00	5:40:30	5:49:00	5:55:00	6:02:30	6:10:30	6:17:30	6:24:00	6:32:00	6:38:30	6:40:30	6:57:30	7:05:30
5:15:00	5:23:00	5:39:00	5:41:30	5:48:00	5:56:30	6:02:30	6:10:00	6:18:30	6:25:30	6:32:00	6:40:00	6:46:30	6:48:30	7:05:30	7:13:30
5:22:30	5:30:30	5:46:30	5:49:00	5:55:30	6:04:00	6:10:00	6:17:30	6:26:00	6:33:00	6:39:30	6:47:30	6:54:00	6:56:00	7:13:00	7:21:00
5:30:00	5:38:00	5:54:00	5:56:30	6:03:00	6:11:30	6:17:30	6:25:00	6:33:30	6:40:30	6:47:00	6:55:00	7:01:30	7:03:30	7:20:30	7:28:30
5:37:00	5:45:00	6:01:30	6:04:00	6:10:30	6:19:00	6:26:00	6:33:30	6:41:00	6:48:00	6:54:30	7:02:30	7:09:00	7:11:00	7:28:00	7:36:00
5:44:00	5:52:00	6:08:30	6:11:00	6:17:30	6:26:00	6:33:00	6:40:30	6:48:00	6:55:00	7:01:30	7:09:30	7:16:00	7:18:00	7:35:00	7:43:00
5:51:30	5:59:30	6:16:00	6:18:30	6:25:00	6:33:30	6:40:30	6:48:00	6:55:30	7:02:30	7:09:00	7:17:00	7:23:30	7:25:30	7:42:30	7:50:30
5:59:00	6:07:00	6:23:30	6:26:00	6:32:30	6:41:00	6:48:00	6:55:30	7:01:00	7:08:30	7:15:00	7:23:00	7:29:30	7:31:30	7:49:00	7:57:00
-	6:12:30	6:29:00	6:31:30	6:38:00	6:46:30	6:53:30	7:01:00	7:05:00	7:12:30	7:19:00	7:27:00	7:33:30	7:35:30	7:53:00	8:01:00
-	6:17:30	6:34:00	6:36:30	6:43:00	6:51:30	6:58:30	7:06:00	7:09:00	7:16:30	7:23:00	7:31:00	7:37:30	7:39:30	7:57:00	-
6:20:00	6:28:00	6:38:00	6:40:30	6:47:00	6:55:30	7:02:30	7:10:00	7:13:00	7:20:30	7:27:00	7:35:00	7:41:30	7:43:30	8:01:00	8:09:00
-	6:25:30	6:42:00	6:44:30	6:51:00	6:59:30	7:06:30	7:14:00	7:17:00	7:24:30	7:31:00	7:39:00	7:45:30	7:47:30	8:05:00	8:13:00
6:28:00	6:36:00	6:46:00	6:48:30	6:55:00	7:03:30	7:10:30	7:18:00	7:21:00	7:28:30	7:35:00	7:43:00	7:49:30	7:51:30	8:09:00	8:17:00
-	6:33:30	6:50:00	6:52:30	6:59:00	7:07:30	7:14:30	7:22:00	7:25:00	7:32:30	7:39:00	7:47:00	7:53:30	7:55:30	8:13:00	-
6:36:00	6:44:00	6:54:00	6:56:30	7:03:00	7:11:30	7:18:30	7:26:00	7:29:00	7:36:30	7:43:00	7:51:00	7:57:30	7:59:30	8:17:00	8:25:00
-	6:40:30	6:57:00	6:59:30	7:06:00	7:14:30	7:21:30	7:29:00	7:32:00	7:39:30	7:46:00	7:54:00	8:00:30	8:02:30	8:20:00	8:28:00
6:41:00	6:49:30	7:00:00	7:02:30	7:10:00	7:18:30	7:25:30	7:33:00	7:35:00	7:42:30	7:49:00	7:57:00	8:03:30	8:05:30	8:23:00	8:31:00

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-6. Future Baseline (CBTC) Operating Plan – 6 Line – Pelham-Lexington Avenue Local

Pelham Bay Park	Parkchester	3 Avenue-138 Street	125 Street	86 Street	Grand Central - 42 Street	14 Street - Union Sq	Brooklyn Bridge	Brooklyn Bridge	14 Street - Union Sq	Grand Central - 42 Street	86 Street	125 Street	3 Avenue-138 Street	Parkchester	Pelham Bay Park
-	6:45:30	7:02:00	7:04:30	7:12:00	7:20:30	7:27:30	7:35:00	7:37:00	7:44:30	7:51:00	7:59:00	8:05:30	8:07:30	8:25:00	-
6:45:00	6:53:30	7:04:00	7:06:30	7:14:00	7:22:30	7:29:30	7:37:00	7:39:00	7:46:30	7:53:00	8:01:00	8:07:30	8:09:30	8:27:00	8:35:00
-	6:49:30	7:06:00	7:08:30	7:16:00	7:24:30	7:31:30	7:39:00	7:41:00	7:48:30	7:55:00	8:03:00	8:09:30	8:11:30	8:29:00	-
6:49:00	6:57:30	7:08:00	7:10:30	7:18:00	7:26:30	7:33:30	7:41:00	7:43:00	7:50:30	7:57:00	8:05:00	8:11:30	8:13:30	8:31:00	8:39:00
-	6:53:30	7:10:00	7:12:30	7:20:00	7:28:30	7:35:30	7:43:00	7:45:00	7:52:30	7:59:00	8:07:00	8:13:30	8:15:30	8:33:00	-
6:53:00	7:01:30	7:12:00	7:14:30	7:22:00	7:30:30	7:37:30	7:45:00	7:47:00	7:54:30	8:01:00	8:09:00	8:15:30	8:17:30	8:35:00	8:43:00
-	6:57:30	7:14:00	7:16:30	7:24:00	7:32:30	7:39:30	7:47:00	7:49:00	7:56:30	8:03:00	8:11:00	8:17:30	8:19:30	8:37:00	-
6:57:00	7:05:30	7:16:00	7:18:30	7:26:00	7:34:30	7:41:30	7:49:00	7:51:00	7:58:30	8:05:00	8:13:00	8:19:30	8:21:30	8:39:00	8:47:00
-	7:01:30	7:18:00	7:20:30	7:28:00	7:36:30	7:43:30	7:51:00	7:53:00	8:00:30	8:07:00	8:15:00	8:21:30	8:23:30	8:41:00	-
7:01:00	7:09:30	7:20:00	7:22:30	7:30:00	7:38:30	7:45:30	7:53:00	7:55:00	8:02:30	8:09:00	8:17:00	8:23:30	8:25:30	8:43:00	8:51:00
-	7:05:30	7:22:00	7:24:30	7:32:00	7:40:30	7:47:30	7:55:00	7:57:00	8:04:30	8:11:00	8:19:00	8:25:30	8:27:30	8:45:00	-
7:05:00	7:13:30	7:24:00	7:26:30	7:34:00	7:42:30	7:49:30	7:57:00	7:59:00	8:06:30	8:13:00	8:21:00	8:27:30	8:29:30	8:47:00	8:55:00
-	7:09:30	7:26:00	7:28:30	7:36:00	7:44:30	7:51:30	7:59:00	8:01:00	8:08:30	8:15:00	8:23:00	8:29:30	8:31:30	8:49:00	-
7:09:00	7:17:30	7:28:00	7:30:30	7:38:00	7:46:30	7:53:30	8:01:00	8:03:00	8:10:30	8:17:00	8:25:00	8:31:30	8:33:30	8:51:00	8:59:00
-	7:13:30	7:30:00	7:32:30	7:40:00	7:48:30	7:55:30	8:03:00	8:05:00	8:12:30	8:19:00	8:27:00	8:33:30	8:35:30	8:53:00	-
7:13:00	7:21:30	7:32:00	7:34:30	7:42:00	7:50:30	7:57:30	8:05:00	8:07:00	8:14:30	8:21:00	8:29:00	8:35:30	8:37:30	8:55:00	9:03:00
-	7:17:30	7:34:00	7:36:30	7:44:00	7:52:30	7:59:30	8:07:00	8:09:00	8:16:30	8:23:00	8:31:00	8:37:30	8:39:30	8:57:00	-
7:17:00	7:25:30	7:36:00	7:38:30	7:46:00	7:54:30	8:01:30	8:09:00	8:11:00	8:18:30	8:25:00	8:33:00	8:39:30	8:41:30	8:59:00	9:07:00
-	7:21:30	7:38:00	7:40:30	7:48:00	7:56:30	8:03:30	8:11:00	8:13:00	8:20:30	8:27:00	8:35:00	8:41:30	8:43:30	9:01:00	-
7:21:00	7:29:30	7:40:00	7:42:30	7:50:00	7:58:30	8:05:30	8:13:00	8:15:00	8:22:30	8:29:00	8:37:00	8:43:30	8:45:30	9:03:00	9:11:00
-	7:25:30	7:42:00	7:44:30	7:52:00	8:00:30	8:07:30	8:15:00	8:17:00	8:24:30	8:31:00	8:39:00	8:45:30	8:47:30	9:05:00	-
7:25:00	7:33:30	7:44:00	7:46:30	7:54:00	8:02:30	8:09:30	8:17:00	8:19:00	8:26:30	8:33:00	8:41:00	8:47:30	8:49:30	9:07:00	9:15:00
-	7:29:30	7:46:00	7:48:30	7:56:00	8:04:30	8:11:30	8:19:00	8:21:00	8:28:30	8:35:00	8:43:00	8:49:30	8:51:30	9:09:00	-
7:29:00	7:37:30	7:48:00	7:50:30	7:58:00	8:06:30	8:13:30	8:21:00	8:23:00	8:30:30	8:37:00	8:45:00	8:51:30	8:53:30	9:11:00	9:19:00
-	7:33:30	7:50:00	7:52:30	8:00:00	8:08:30	8:15:30	8:23:00	8:25:00	8:32:30	8:39:00	8:47:00	8:53:30	8:55:30	9:13:00	-
7:33:00	7:41:30	7:52:00	7:54:30	8:02:00	8:10:30	8:17:30	8:25:00	8:27:00	8:34:30	8:41:00	8:49:00	8:55:30	8:57:30	9:15:00	9:23:00
-	7:37:30	7:54:00	7:56:30	8:04:00	8:12:30	8:19:30	8:27:00	8:29:00	8:36:30	8:43:00	8:51:00	8:57:30	8:59:30	9:17:00	-
7:37:00	7:45:30	7:56:00	7:58:30	8:06:00	8:14:30	8:21:30	8:29:00	8:31:00	8:38:30	8:45:00	8:53:00	8:59:30	9:01:30	9:19:00	9:27:00
-	7:41:30	7:58:00	8:00:30	8:08:00	8:16:30	8:23:30	8:31:00	8:33:00	8:40:30	8:47:00	8:55:00	9:01:30	9:03:30	9:21:00	-
7:41:00	7:49:30	8:00:00	8:02:30	8:10:00	8:18:30	8:25:30	8:33:00	8:35:00	8:42:30	8:49:00	8:57:00	9:03:30	9:05:30	9:23:00	9:31:00
-	7:45:30	8:02:00	8:04:30	8:12:00	8:20:30	8:27:30	8:35:00	8:37:00	8:44:30	8:51:00	8:59:00	9:05:30	9:07:30	9:25:00	-
7:45:00	7:53:30	8:04:00	8:06:30	8:14:00	8:22:30	8:29:30	8:37:00	8:39:00	8:46:30	8:53:00	9:01:00	9:07:30	9:09:30	9:27:00	9:35:00
-	7:49:30	8:06:00	8:08:30	8:16:00	8:24:30	8:31:30	8:39:00	8:41:00	8:48:30	8:55:00	9:03:00	9:09:30	9:11:30	9:29:00	9:37:00
7:49:00	7:57:30	8:08:00	8:10:30	8:18:00	8:26:30	8:33:30	8:41:00	8:43:00	8:50:30	8:57:00	9:05:00	9:11:30	9:13:30	9:31:00	-
-	7:53:30	8:10:00	8:12:30	8:20:00	8:28:30	8:35:30	8:43:00	8:45:00	8:52:30	8:59:00	9:07:00	9:13:30	9:15:30	9:33:00	9:41:00
7:53:00	8:01:30	8:12:00	8:14:30	8:22:00	8:30:30	8:37:30	8:45:00	8:47:00	8:54:30	9:01:00	9:09:00	9:15:30	9:17:30	9:35:00	9:43:00

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-6. Future Baseline (CBTC) Operating Plan – 6 Line – Pelham-Lexington Avenue Local

Pelham Bay Park	Parkchester	3 Avenue-138 Street	125 Street	86 Street	Grand Central - 42 Street	14 Street - Union Sq	Brooklyn Bridge	Brooklyn Bridge	14 Street - Union Sq	Grand Central - 42 Street	86 Street	125 Street	3 Avenue-138 Street	Parkchester	Pelham Bay Park
-	7:57:30	8:14:00	8:16:30	8:24:00	8:32:30	8:39:30	8:47:00	8:49:00	8:56:30	9:03:00	9:11:00	9:17:30	9:19:30	9:37:00	-
7:57:00	8:05:30	8:16:00	8:18:30	8:26:00	8:34:30	8:41:30	8:49:00	8:51:00	8:58:30	9:05:00	9:13:00	9:19:30	9:21:30	9:39:00	9:47:00
-	8:01:30	8:18:00	8:20:30	8:28:00	8:36:30	8:43:30	8:51:00	8:53:00	9:00:30	9:07:00	9:15:00	9:21:30	9:23:30	9:41:00	9:49:00
8:01:00	8:09:30	8:20:00	8:22:30	8:30:00	8:38:30	8:45:30	8:53:00	8:55:00	9:02:00	9:08:30	9:16:30	9:23:00	9:25:00	9:42:00	-
-	8:05:30	8:22:00	8:24:30	8:32:00	8:40:30	8:47:30	8:55:00	8:57:00	9:04:00	9:10:30	9:18:30	9:25:00	9:27:00	9:44:00	9:52:00
8:05:00	8:13:30	8:24:00	8:26:30	8:34:00	8:42:30	8:49:30	8:57:00	8:59:00	9:06:00	9:12:30	9:20:30	9:27:00	9:29:00	9:46:00	9:54:00
-	8:09:30	8:26:00	8:28:30	8:36:00	8:44:30	8:51:30	8:59:00	9:01:00	9:08:00	9:14:30	9:22:30	9:29:00	9:31:00	9:48:00	-
8:09:00	8:17:30	8:28:00	8:30:30	8:38:00	8:46:30	8:53:30	9:01:00	9:03:00	9:10:00	9:16:30	9:24:30	9:31:00	9:33:00	9:50:00	9:58:00
-	8:13:30	8:30:00	8:32:30	8:40:00	8:48:30	8:55:30	9:03:00	9:05:00	9:12:00	9:18:30	9:26:30	9:33:00	9:35:00	9:52:00	-
8:13:00	8:21:30	8:32:00	8:34:30	8:42:00	8:50:30	8:57:30	9:05:00	9:07:00	9:14:00	9:20:30	9:28:30	9:35:00	9:37:00	9:54:00	10:02:00
-	8:17:30	8:34:00	8:36:30	8:44:00	8:52:30	8:59:30	9:07:00	9:09:00	9:16:00	9:22:30	9:30:30	9:37:00	9:39:00	9:55:00	-
8:17:00	8:25:30	8:36:00	8:38:30	8:46:00	8:54:30	9:01:30	9:09:00	9:11:00	9:18:00	9:24:30	9:32:30	9:39:00	9:41:00	9:58:00	10:06:00
-	8:21:30	8:38:00	8:40:30	8:48:00	8:56:30	9:03:30	9:11:00	9:13:00	9:20:00	9:26:30	9:34:30	9:41:00	9:43:00	9:59:00	-
8:21:00	8:29:30	8:40:00	8:42:30	8:50:00	8:58:30	9:05:30	9:13:00	9:15:00	9:22:00	9:28:30	9:36:30	9:43:00	9:45:00	10:02:00	10:10:00
-	8:25:30	8:42:00	8:44:30	8:52:00	9:00:30	9:07:30	9:15:00	9:17:00	9:24:00	9:30:30	9:38:30	9:45:00	9:47:00	10:03:00	-
8:25:00	8:33:30	8:44:00	8:46:30	8:54:00	9:02:30	9:09:30	9:17:00	9:19:00	9:26:00	9:32:30	9:40:30	9:47:00	9:49:00	10:06:00	10:14:00
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8:29:00	8:37:30	8:48:00	8:50:30	8:58:00	9:06:30	9:13:30	9:21:00	9:23:00	9:30:00	9:36:30	9:44:30	9:51:00	9:53:00	10:10:00	10:18:00
-	8:33:30	8:50:00	8:52:30	9:00:00	9:08:30	9:15:30	9:23:00	9:25:00	9:32:00	9:38:30	9:46:30	9:53:00	9:55:00	10:11:00	-
8:33:00	8:41:30	8:52:00	8:54:30	9:02:00	9:10:30	9:17:30	9:25:00	9:27:00	9:34:00	9:40:30	9:48:30	9:55:00	9:57:00	10:14:00	10:22:00
-	8:37:30	8:54:00	8:56:30	9:04:00	9:12:30	9:19:30	9:27:00	9:29:00	9:36:00	9:42:30	9:50:30	9:57:00	9:59:00	10:15:00	-
8:37:00	8:45:30	8:56:00	8:58:30	9:06:00	9:14:30	9:21:30	9:29:00	9:32:00	9:39:00	9:45:30	9:53:30	10:00:00	10:02:00	10:19:00	10:27:00
-	8:42:30	8:59:00	9:01:30	9:09:00	9:17:30	9:24:30	9:32:00	9:36:00	9:43:00	9:49:30	9:57:30	10:04:00	10:06:00	10:22:00	-
8:47:00	8:55:00	9:05:00	9:07:30	9:14:00	9:22:30	9:29:30	9:37:00	9:41:00	9:48:00	9:54:30	10:02:30	10:09:00	10:11:00	10:27:00	-
8:51:00	8:59:00	9:09:00	9:11:30	9:18:00	9:26:30	9:33:30	9:41:00	9:45:00	9:52:00	9:58:30	10:06:30	10:13:00	10:15:00	10:32:00	10:40:00
8:55:00	9:03:00	9:13:00	9:15:30	9:22:00	9:30:30	9:37:30	9:45:00	9:49:00	9:56:00	10:02:30	10:10:30	10:17:00	10:19:00	10:36:00	10:44:00
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9:03:00	9:11:00	9:21:00	9:23:30	9:30:00	9:38:30	9:45:30	9:53:00	9:57:00	10:04:00	10:09:30	10:17:30	10:24:00	10:26:00	10:41:00	-
9:07:00	9:15:00	9:25:00	9:27:30	9:34:00	9:42:30	9:49:30	9:57:00	10:01:00	10:08:00	10:13:30	10:21:30	10:28:00	10:30:00	10:47:00	10:55:00
9:11:00	9:19:00	9:29:00	9:31:30	9:38:00	9:46:30	9:53:30	10:01:00	10:05:00	10:12:00	10:17:30	10:25:30	10:32:00	10:34:00	10:51:00	-
-	9:16:30	9:33:00	9:35:30	9:42:00	9:50:30	9:57:30	10:05:00	10:09:00	10:16:00	10:21:30	10:29:30	10:36:00	10:38:00	10:55:00	11:03:00
9:19:00	9:27:00	9:37:00	9:39:30	9:46:00	9:54:30	10:01:30	10:09:00	10:13:00	10:20:00	10:25:30	10:33:30	10:40:00	10:42:00	10:59:00	-
-	9:24:30	9:41:00	9:43:30	9:50:00	9:58:30	10:05:30	10:13:00	10:17:00	10:24:00	10:29:30	10:37:30	10:44:00	10:46:00	11:03:00	11:11:00
9:27:00	9:35:00	9:45:00	9:47:30	9:54:00	10:02:30	10:09:30	10:17:00	10:21:00	10:28:00	10:33:30	10:41:30	10:48:00	10:50:00	11:07:00	-
-	9:32:30	9:49:00	9:51:30	9:58:00	10:06:30	10:13:30	10:21:00	10:25:00	10:32:00	10:37:30	10:45:30	10:52:00	10:54:00	11:11:00	11:19:00
9:31:30	9:39:30	9:53:00	9:55:30	10:02:00	10:10:30	10:17:30	10:25:00	10:29:00	10:36:00	10:41:30	10:49:30	10:56:00	10:58:00	11:15:00	-

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-6. Future Baseline (CBTC) Operating Plan – 6 Line – Pelham-Lexington Avenue Local

Pelham Bay Park	Parkchester	3 Avenue-138 Street	125 Street	86 Street	Grand Central - 42 Street	14 Street - Union Sq	Brooklyn Bridge	Brooklyn Bridge	14 Street - Union Sq	Grand Central - 42 Street	86 Street	125 Street	3 Avenue-138 Street	Parkchester	Pelham Bay Park
-	9:41:00	9:57:30	10:00:00	10:06:30	10:15:00	10:22:00	10:29:30	10:33:00	10:40:00	10:45:30	10:53:30	11:00:00	11:02:00	11:19:00	11:27:00
9:40:30	9:48:30	10:01:30	10:04:00	10:10:30	10:19:00	10:25:00	10:32:30	10:37:00	10:44:00	10:49:30	10:57:30	11:04:00	11:06:00	11:23:00	-
9:44:30	9:52:30	10:05:30	10:08:00	10:14:30	10:23:00	10:29:00	10:36:30	10:41:00	10:48:00	10:53:30	11:01:30	11:08:00	11:10:00	11:27:00	11:35:00
9:49:30	9:57:30	10:10:30	10:13:00	10:19:30	10:28:00	10:34:00	10:41:30	10:45:00	10:52:00	10:57:30	11:05:30	11:12:00	11:14:00	11:31:00	-
-	9:58:30	10:14:30	10:17:00	10:23:30	10:32:00	10:38:00	10:45:30	10:49:00	10:56:00	11:01:30	11:09:30	11:16:00	11:18:00	11:35:00	11:43:00
9:57:00	10:05:00	10:18:00	10:20:30	10:27:00	10:35:30	10:41:30	10:49:00	10:53:00	11:00:00	11:05:30	11:13:30	11:20:00	11:22:00	11:39:00	-
-	10:06:00	10:22:00	10:24:30	10:31:00	10:39:30	10:45:30	10:53:00	10:57:00	11:04:00	11:09:30	11:17:30	11:24:00	11:26:00	11:43:00	11:51:00
10:05:00	10:13:00	10:26:00	10:28:30	10:35:00	10:43:30	10:49:30	10:57:00	11:01:00	11:08:00	11:13:30	11:21:30	11:28:00	11:30:00	11:47:00	-
-	10:14:00	10:30:00	10:32:30	10:39:00	10:47:30	10:53:30	11:01:00	11:05:00	11:12:00	11:17:30	11:25:30	11:32:00	11:34:00	11:51:00	11:59:00
10:13:00	10:21:00	10:34:00	10:36:30	10:43:00	10:51:30	10:57:30	11:05:00	11:09:00	11:16:00	11:21:30	11:29:30	11:36:00	11:38:00	11:55:00	-
-	10:22:00	10:38:00	10:40:30	10:47:00	10:55:30	11:01:30	11:09:00	11:13:00	11:20:00	11:25:30	11:33:30	11:40:00	11:42:00	11:59:00	12:07:00
10:21:00	10:29:00	10:42:00	10:44:30	10:51:00	10:59:30	11:05:30	11:13:00	11:17:00	11:24:00	11:29:30	11:37:30	11:44:00	11:46:00	12:03:00	-
-	10:30:00	10:46:00	10:48:30	10:55:00	11:03:30	11:09:30	11:17:00	11:21:00	11:28:00	11:33:30	11:41:30	11:48:00	11:50:00	12:07:00	12:15:00
10:29:00	10:37:00	10:50:00	10:52:30	10:59:00	11:07:30	11:13:30	11:21:00	11:25:00	11:32:00	11:37:30	11:45:30	11:52:00	11:54:00	12:11:00	-
-	10:38:00	10:54:00	10:56:30	11:03:00	11:11:30	11:17:30	11:25:00	11:29:00	11:36:00	11:41:30	11:49:30	11:56:00	11:58:00	12:15:00	12:23:00
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10:48:00	10:56:00	11:06:30	11:09:00	11:15:30	11:24:00	11:30:00	11:37:30	11:41:30	11:48:30	11:54:00	12:02:00	12:08:30	12:10:30	12:27:30	-
-	10:54:30	11:10:30	11:13:00	11:19:30	11:28:00	11:34:00	11:41:30	11:45:30	11:52:30	11:58:00	12:06:00	12:12:30	12:14:30	12:31:30	12:39:30
10:56:00	11:04:00	11:14:30	11:17:00	11:23:30	11:32:00	11:38:00	11:45:30	11:49:30	11:56:30	12:02:00	12:10:00	12:16:30	12:18:30	12:35:30	-
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11:04:00	11:12:00	11:22:30	11:25:00	11:31:30	11:40:00	11:46:00	11:53:30	11:57:30	12:04:30	12:10:00	12:18:00	12:24:30	12:26:30	12:43:30	-
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11:12:00	11:20:00	11:30:30	11:33:00	11:39:30	11:48:00	11:54:00	12:01:30	12:05:30	12:12:30	12:18:00	12:26:00	12:32:30	12:34:30	12:51:30	-
-	11:18:30	11:34:30	11:37:00	11:43:30	11:52:00	11:58:00	12:05:30	12:09:30	12:16:30	12:22:00	12:30:00	12:36:30	12:38:30	12:55:30	13:03:30
11:20:00	11:28:00	11:38:30	11:41:00	11:47:30	11:56:00	12:02:00	12:09:30	12:13:30	12:20:30	12:26:00	12:34:00	12:40:30	12:42:30	12:59:30	-
-	11:26:30	11:42:30	11:45:00	11:51:30	12:00:00	12:06:00	12:13:30	12:17:30	12:24:30	12:30:00	12:38:00	12:44:30	12:46:30	13:03:30	13:11:30
11:28:00	11:36:00	11:46:30	11:49:00	11:55:30	12:04:00	12:10:00	12:17:30	12:21:30	12:28:30	12:34:00	12:42:00	12:48:30	12:50:30	13:07:30	-
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11:36:00	11:44:00	11:54:30	11:57:00	12:03:30	12:12:00	12:18:00	12:25:30	12:29:30	12:36:30	12:42:00	12:50:00	12:56:30	12:58:30	13:15:30	-
-	11:42:30	11:58:30	12:01:00	12:07:30	12:16:00	12:22:00	12:29:30	12:33:30	12:40:30	12:46:00	12:54:00	13:00:30	13:02:30	13:14:30	13:22:30
11:44:00	11:52:00	12:02:30	12:05:00	12:11:30	12:20:00	12:26:00	12:33:30	12:37:30	12:44:30	12:50:00	12:58:00	13:04:30	13:06:30	13:23:30	-
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11:52:00	12:00:00	12:10:30	12:13:00	12:19:30	12:28:00	12:34:00	12:41:30	12:45:30	12:52:30	12:58:00	13:06:00	13:12:30	13:14:30	13:31:30	-
-	11:58:30	12:14:30	12:17:00	12:23:30	12:32:00	12:38:00	12:45:30	12:49:30	12:56:30	13:02:00	13:10:00	13:16:30	13:18:30	13:28:30	13:36:30
12:00:00	12:08:00	12:18:30	12:21:00	12:27:30	12:36:00	12:42:00	12:49:30	12:53:30	13:00:30	13:06:00	13:14:00	13:20:30	13:22:30	13:39:30	-

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-6. Future Baseline (CBTC) Operating Plan – 6 Line – Pelham-Lexington Avenue Local

Pelham Bay Park	Parkchester	3 Avenue-138 Street	125 Street	86 Street	Grand Central - 42 Street	14 Street - Union Sq	Brooklyn Bridge	Brooklyn Bridge	14 Street - Union Sq	Grand Central - 42 Street	86 Street	125 Street	3 Avenue-138 Street	Parkchester	Pelham Bay Park
-	12:06:30	12:22:30	12:25:00	12:31:30	12:40:00	12:46:00	12:53:30	12:57:30	13:04:30	13:10:00	13:18:00	13:24:30	13:26:30	13:36:30	13:44:30
12:08:00	12:16:00	12:26:30	12:29:00	12:35:30	12:44:00	12:50:00	12:57:30	13:01:30	13:08:30	13:14:00	13:22:00	13:28:30	13:30:30	13:47:30	-
-	12:14:30	12:30:30	12:33:00	12:39:30	12:48:00	12:54:00	13:01:30	13:05:30	13:12:30	13:18:00	13:26:00	13:32:30	13:34:30	13:44:30	13:52:30
12:16:00	12:24:00	12:34:30	12:37:00	12:43:30	12:52:00	12:58:00	13:05:30	13:09:30	13:16:30	13:22:00	13:30:00	13:36:30	13:38:30	13:55:30	-
-	12:22:30	12:38:30	12:41:00	12:47:30	12:56:00	13:02:00	13:09:30	13:13:30	13:20:30	13:26:00	13:34:00	13:40:30	13:42:30	13:52:30	14:00:30
12:18:30	12:26:30	12:42:30	12:45:00	12:51:30	13:00:00	13:06:00	13:13:30	13:17:30	13:24:30	13:30:00	13:38:00	13:44:30	13:46:30	14:03:30	-
-	12:30:30	12:46:30	12:49:00	12:55:30	13:04:00	13:10:00	13:17:30	13:21:30	13:28:30	13:34:00	13:42:00	13:48:30	13:50:30	14:00:30	14:08:30
12:26:30	12:34:30	12:50:30	12:53:00	12:59:30	13:08:00	13:14:00	13:21:30	13:25:30	13:32:30	13:38:00	13:46:00	13:52:30	13:54:30	14:11:30	-
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12:34:30	12:42:30	12:58:30	13:01:00	13:07:30	13:16:00	13:22:00	13:29:30	13:33:30	13:40:30	13:46:00	13:54:00	14:00:30	14:02:30	14:19:30	-
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12:42:30	12:50:30	13:06:30	13:09:00	13:15:30	13:24:00	13:30:00	13:37:30	13:41:30	13:48:30	13:54:00	14:02:00	14:08:30	14:10:30	14:27:30	-
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12:50:30	12:58:30	13:14:30	13:17:00	13:23:30	13:32:00	13:38:00	13:45:30	13:49:30	13:56:30	14:02:00	14:10:00	14:16:30	14:18:30	14:35:30	-
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12:58:30	13:06:30	13:22:30	13:25:00	13:31:30	13:40:00	13:46:00	13:53:30	13:57:30	14:04:30	14:10:00	14:18:00	14:24:30	14:26:30	14:43:30	-
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13:06:30	13:14:30	13:30:30	13:33:00	13:39:30	13:48:00	13:54:00	14:01:30	14:05:30	14:12:30	14:18:00	14:26:00	14:32:30	14:34:30	14:51:30	-
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13:14:30	13:22:30	13:38:30	13:41:00	13:47:30	13:56:00	14:02:00	14:09:30	14:13:30	14:20:30	14:26:00	14:34:00	14:40:30	14:42:30	14:59:30	-
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13:22:30	13:30:30	13:46:30	13:49:00	13:55:30	14:04:00	14:10:00	14:17:30	14:21:30	14:28:30	14:34:00	14:42:00	14:48:30	14:50:30	15:07:30	-
-	13:34:30	13:50:30	13:53:00	13:59:30	14:08:00	14:14:00	14:21:30	14:25:30	14:32:30	14:38:00	14:46:00	14:52:30	14:54:30	15:04:30	15:12:30
13:30:30	13:38:30	13:54:30	13:57:00	14:03:30	14:12:00	14:18:00	14:25:30	14:29:30	14:36:30	14:42:00	14:50:00	14:56:30	14:58:30	15:15:30	-
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13:38:30	13:46:30	14:02:30	14:05:00	14:11:30	14:20:00	14:26:00	14:33:30	14:37:30	14:44:30	14:50:00	14:58:00	15:04:30	15:06:30	15:23:30	-
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13:46:30	13:54:30	14:10:30	14:13:00	14:19:30	14:28:00	14:34:00	14:41:30	14:45:30	14:52:30	14:58:00	15:06:00	15:12:30	15:14:30	15:31:30	-
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13:54:30	14:02:30	14:18:30	14:21:00	14:27:30	14:36:00	14:42:00	14:49:30	14:53:30	15:00:30	15:07:00	15:15:00	15:21:30	15:23:30	15:40:30	-
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14:02:30	14:10:30	14:26:30	14:29:00	14:35:30	14:44:00	14:50:00	14:57:30	15:01:30	15:08:30	15:15:00	15:23:00	15:29:30	15:31:30	15:48:30	-
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14:11:00	14:19:00	14:35:00	14:37:30	14:44:00	14:52:30	14:58:30	15:06:00	15:10:00	15:17:00	15:23:30	15:31:30	15:38:00	15:40:00	15:57:00	-
-	14:23:00	14:39:00	14:41:30	14:48:00	14:56:30	15:02:30	15:10:00	15:14:00	15:21:00	15:27:30	15:35:30	15:42:00	15:44:00	15:54:00	16:02:00
14:19:00	14:27:00	14:43:00	14:45:30	14:52:00	15:00:30	15:06:30	15:14:00	15:17:00	15:24:00	15:30:30	15:38:30	15:45:00	15:47:00	16:04:00	-

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-6. Future Baseline (CBTC) Operating Plan – 6 Line – Pelham-Lexington Avenue Local

Pelham Bay Park	Parkchester	3 Avenue-138 Street	125 Street	86 Street	Grand Central - 42 Street	14 Street - Union Sq	Brooklyn Bridge	Brooklyn Bridge	14 Street - Union Sq	Grand Central - 42 Street	86 Street	125 Street	3 Avenue-138 Street	Parkchester	Pelham Bay Park
-	14:31:00	14:47:00	14:49:30	14:56:00	15:04:30	15:10:30	15:18:00	15:22:00	15:29:00	15:35:30	15:43:30	15:50:00	15:52:00	16:02:00	16:10:00
14:27:00	14:35:00	14:51:00	14:53:30	15:00:00	15:08:30	15:14:30	15:22:00	15:26:00	15:33:00	15:39:30	15:47:30	15:54:00	15:56:00	16:13:00	-
-	14:39:00	14:55:00	14:57:30	15:04:00	15:12:30	15:18:30	15:26:00	15:30:00	15:37:00	15:43:30	15:51:30	15:58:00	16:00:00	16:10:00	16:18:00
14:35:00	14:43:00	14:59:00	15:01:30	15:08:00	15:16:30	15:22:30	15:30:00	15:34:00	15:41:00	15:47:30	15:55:30	16:02:00	16:04:00	16:21:00	-
-	14:46:30	15:03:00	15:05:30	15:12:00	15:20:30	15:27:30	15:35:00	15:38:00	15:45:00	15:51:30	15:59:30	16:06:00	16:08:00	16:18:00	16:26:00
14:42:30	14:50:30	15:07:00	15:09:30	15:16:00	15:24:30	15:31:30	15:39:00	15:42:00	15:49:00	15:55:30	16:03:30	16:10:00	16:12:00	16:29:00	-
-	14:54:30	15:11:00	15:13:30	15:20:00	15:28:30	15:35:30	15:43:00	15:46:00	15:53:00	15:59:30	16:07:30	16:14:00	16:16:00	16:26:00	16:34:00
14:50:30	14:58:30	15:15:00	15:17:30	15:24:00	15:32:30	15:39:30	15:47:00	15:50:00	15:57:00	16:03:30	16:11:30	16:18:00	16:20:00	16:37:00	-
-	15:02:30	15:19:00	15:21:30	15:28:00	15:36:30	15:43:30	15:51:00	15:53:00	16:00:30	16:07:00	16:15:00	16:21:30	16:23:30	16:34:00	16:42:00
14:57:30	15:05:30	15:22:00	15:24:30	15:31:00	15:39:30	15:46:30	15:54:00	15:56:00	16:03:30	16:10:00	16:18:00	16:24:30	16:26:30	16:44:00	-
-	15:07:30	15:24:00	15:26:30	15:33:00	15:41:30	15:48:30	15:56:00	15:58:00	16:05:30	16:12:00	16:20:00	16:26:30	16:28:30	16:39:00	16:47:00
15:01:30	15:09:30	15:26:00	15:28:30	15:35:00	15:43:30	15:50:30	15:58:00	16:00:00	16:07:30	16:14:00	16:22:00	16:28:30	16:30:30	16:48:00	-
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15:05:30	15:13:30	15:30:00	15:32:30	15:39:00	15:47:30	15:54:30	16:02:00	16:04:00	16:11:30	16:18:00	16:26:00	16:32:30	16:34:30	16:52:00	-
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15:09:30	15:17:30	15:34:00	15:36:30	15:43:00	15:51:30	15:58:30	16:06:00	16:08:00	16:15:30	16:22:00	16:30:00	16:36:30	16:38:30	16:56:00	-
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15:13:30	15:21:30	15:38:00	15:40:30	15:47:00	15:55:30	16:02:30	16:10:00	16:12:00	16:19:30	16:26:00	16:34:00	16:40:30	16:42:30	17:00:00	-
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15:17:30	15:25:30	15:42:00	15:44:30	15:51:00	15:59:30	16:06:30	16:14:00	16:16:00	16:23:30	16:30:00	16:38:00	16:44:30	16:46:30	17:04:00	-
-	15:27:30	15:44:00	15:46:30	15:53:00	16:01:30	16:08:30	16:16:00	16:18:00	16:25:30	16:32:00	16:40:00	16:46:30	16:48:30	16:59:00	17:07:00
15:21:30	15:29:30	15:46:00	15:48:30	15:55:00	16:03:30	16:10:30	16:18:00	16:20:00	16:27:30	16:34:00	16:42:00	16:48:30	16:50:30	17:08:00	-
-	15:31:30	15:48:00	15:50:30	15:57:00	16:05:30	16:12:30	16:20:00	16:22:00	16:29:30	16:36:00	16:44:00	16:50:30	16:52:30	17:03:00	17:11:00
15:25:30	15:33:30	15:50:00	15:52:30	15:59:00	16:07:30	16:14:30	16:22:00	16:24:00	16:31:30	16:38:00	16:46:00	16:52:30	16:54:30	17:12:00	-
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15:29:30	15:37:30	15:54:00	15:56:30	16:03:00	16:11:30	16:18:30	16:26:00	16:28:00	16:35:30	16:42:00	16:50:00	16:56:30	16:58:30	17:16:00	-
-	15:39:30	15:56:00	15:58:30	16:05:00	16:13:30	16:20:30	16:28:00	16:30:00	16:37:30	16:44:00	16:52:00	16:58:30	17:00:30	17:11:00	17:19:00
15:33:30	15:41:30	15:58:00	16:00:30	16:07:00	16:15:30	16:22:30	16:30:00	16:32:00	16:39:30	16:46:00	16:54:00	17:00:30	17:02:30	17:20:00	-
-	15:43:30	16:00:00	16:02:30	16:10:00	16:18:30	16:25:30	16:33:00	16:35:00	16:42:30	16:49:00	16:57:00	17:03:30	17:05:30	17:16:00	17:24:00
15:37:00	15:45:30	16:02:00	16:04:30	16:12:00	16:20:30	16:27:30	16:35:00	16:37:00	16:44:30	16:51:00	16:59:00	17:05:30	17:07:30	17:25:00	-
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15:49:00	15:57:30	16:14:00	16:16:30	16:24:00	16:32:30	16:39:30	16:47:00	16:49:00	16:56:30	17:03:00	17:11:00	17:17:30	17:19:30	17:37:00	-

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-6. Future Baseline (CBTC) Operating Plan – 6 Line – Pelham-Lexington Avenue Local

Pelham Bay Park	Parkchester	3 Avenue-138 Street	125 Street	86 Street	Grand Central - 42 Street	14 Street - Union Sq	Brooklyn Bridge	Brooklyn Bridge	14 Street - Union Sq	Grand Central - 42 Street	86 Street	125 Street	3 Avenue-138 Street	Parkchester	Pelham Bay Park
-	15:59:30	16:16:00	16:18:30	16:26:00	16:34:30	16:41:30	16:49:00	16:51:00	16:58:30	17:05:00	17:13:00	17:19:30	17:21:30	17:32:00	17:40:00
15:53:00	16:01:30	16:18:00	16:20:30	16:28:00	16:36:30	16:43:30	16:51:00	16:53:00	17:00:30	17:07:00	17:15:00	17:21:30	17:23:30	17:41:00	-
-	16:03:30	16:20:00	16:22:30	16:30:00	16:38:30	16:45:30	16:53:00	16:55:00	17:02:30	17:09:00	17:17:00	17:23:30	17:25:30	17:36:00	17:44:00
15:57:00	16:05:30	16:22:00	16:24:30	16:32:00	16:40:30	16:47:30	16:55:00	16:57:00	17:04:30	17:11:00	17:19:00	17:25:30	17:27:30	17:45:00	-
-	16:07:30	16:24:00	16:26:30	16:34:00	16:42:30	16:49:30	16:57:00	16:59:00	17:06:30	17:13:00	17:21:00	17:27:30	17:29:30	17:40:00	17:48:00
16:01:00	16:09:30	16:26:00	16:28:30	16:36:00	16:44:30	16:51:30	16:59:00	17:01:00	17:08:30	17:15:00	17:23:00	17:29:30	17:31:30	17:49:00	-
-	16:11:30	16:28:00	16:30:30	16:38:00	16:46:30	16:53:30	17:01:00	17:03:00	17:10:30	17:17:00	17:25:00	17:31:30	17:33:30	17:44:00	17:52:00
16:05:00	16:13:30	16:30:00	16:32:30	16:40:00	16:48:30	16:55:30	17:03:00	17:05:00	17:12:30	17:19:00	17:27:00	17:33:30	17:35:30	17:53:00	-
-	16:15:30	16:32:00	16:34:30	16:42:00	16:50:30	16:57:30	17:05:00	17:07:00	17:14:30	17:21:00	17:29:00	17:35:30	17:37:30	17:48:00	17:56:00
16:09:00	16:17:30	16:34:00	16:36:30	16:44:00	16:52:30	16:59:30	17:07:00	17:09:00	17:16:30	17:23:00	17:31:00	17:37:30	17:39:30	17:57:00	-
-	16:19:30	16:36:00	16:38:30	16:46:00	16:54:30	17:01:30	17:09:00	17:11:00	17:18:30	17:25:00	17:33:00	17:39:30	17:41:30	17:52:00	18:00:00
16:13:00	16:21:30	16:38:00	16:40:30	16:48:00	16:56:30	17:03:30	17:11:00	17:13:00	17:20:30	17:27:00	17:35:00	17:41:30	17:43:30	18:01:00	-
-	16:23:30	16:40:00	16:42:30	16:50:00	16:58:30	17:05:30	17:13:00	17:15:00	17:22:30	17:29:00	17:37:00	17:43:30	17:45:30	17:56:00	18:04:00
16:17:00	16:25:30	16:42:00	16:44:30	16:52:00	17:00:30	17:07:30	17:15:00	17:17:00	17:24:30	17:31:00	17:39:00	17:45:30	17:47:30	18:05:00	-
-	16:27:30	16:44:00	16:46:30	16:54:00	17:02:30	17:09:30	17:17:00	17:19:00	17:26:30	17:33:00	17:41:00	17:47:30	17:49:30	18:00:00	18:08:00
16:21:00	16:29:30	16:46:00	16:48:30	16:56:00	17:04:30	17:11:30	17:19:00	17:21:00	17:28:30	17:35:00	17:43:00	17:49:30	17:51:30	18:09:00	-
-	16:31:30	16:48:00	16:50:30	16:58:00	17:06:30	17:13:30	17:21:00	17:23:00	17:30:30	17:37:00	17:45:00	17:51:30	17:53:30	18:04:00	18:12:00
16:25:00	16:33:30	16:50:00	16:52:30	17:00:00	17:08:30	17:15:30	17:23:00	17:25:00	17:32:30	17:39:00	17:47:00	17:53:30	17:55:30	18:13:00	-
-	16:35:30	16:52:00	16:54:30	17:02:00	17:10:30	17:17:30	17:25:00	17:27:00	17:34:30	17:41:00	17:49:00	17:55:30	17:57:30	18:08:00	18:16:00
16:29:00	16:37:30	16:54:00	16:56:30	17:04:00	17:12:30	17:19:30	17:27:00	17:29:00	17:36:30	17:43:00	17:51:00	17:57:30	17:59:30	18:17:00	-
-	16:39:30	16:56:00	16:58:30	17:06:00	17:14:30	17:21:30	17:29:00	17:31:00	17:38:30	17:45:00	17:53:00	17:59:30	18:01:30	18:12:00	18:20:00
16:33:00	16:41:30	16:58:00	17:00:30	17:08:00	17:16:30	17:23:30	17:31:00	17:33:00	17:40:30	17:47:00	17:55:00	18:01:30	18:03:30	18:21:00	-
-	16:43:30	17:00:00	17:02:30	17:10:00	17:18:30	17:25:30	17:33:00	17:35:00	17:42:30	17:49:00	17:57:00	18:03:30	18:05:30	18:16:00	18:24:00
16:37:00	16:45:30	17:02:00	17:04:30	17:12:00	17:20:30	17:27:30	17:35:00	17:37:00	17:44:30	17:51:00	17:59:00	18:05:30	18:07:30	18:25:00	-
-	16:47:30	17:04:00	17:06:30	17:14:00	17:22:30	17:29:30	17:37:00	17:39:00	17:46:30	17:53:00	18:01:00	18:07:30	18:09:30	18:20:00	18:28:00
16:41:00	16:49:30	17:06:00	17:08:30	17:16:00	17:24:30	17:31:30	17:39:00	17:41:00	17:48:30	17:55:00	18:03:00	18:09:30	18:11:30	18:29:00	-
-	16:51:30	17:08:00	17:10:30	17:18:00	17:26:30	17:33:30	17:41:00	17:43:00	17:50:30	17:57:00	18:05:00	18:11:30	18:13:30	18:24:00	18:32:00
16:45:00	16:53:30	17:10:00	17:12:30	17:20:00	17:28:30	17:35:30	17:43:00	17:45:00	17:52:30	17:59:00	18:07:00	18:13:30	18:15:30	18:33:00	-
-	16:55:30	17:12:00	17:14:30	17:22:00	17:30:30	17:37:30	17:45:00	17:47:00	17:54:30	18:01:00	18:09:00	18:15:30	18:17:30	18:28:00	18:36:00
16:49:00	16:57:30	17:14:00	17:16:30	17:24:00	17:32:30	17:39:30	17:47:00	17:49:00	17:56:30	18:03:00	18:11:00	18:17:30	18:19:30	18:37:00	-
-	16:59:30	17:16:00	17:18:30	17:26:00	17:34:30	17:41:30	17:49:00	17:51:00	17:58:30	18:05:00	18:13:00	18:19:30	18:21:30	18:32:00	18:40:00
16:53:00	17:01:30	17:18:00	17:20:30	17:28:00	17:36:30	17:43:30	17:51:00	17:53:00	18:00:30	18:07:00	18:15:00	18:21:30	18:23:30	18:41:00	-
-	17:03:30	17:20:00	17:22:30	17:30:00	17:38:30	17:45:30	17:53:00	17:55:00	18:02:00	18:08:30	18:16:30	18:23:00	18:25:00	18:35:00	18:43:00
16:57:00	17:05:30	17:22:00	17:24:30	17:32:00	17:40:30	17:47:30	17:55:00	17:57:00	18:04:00	18:10:30	18:18:30	18:25:00	18:27:00	18:44:00	-
-	17:07:30	17:24:00	17:26:30	17:34:00	17:42:30	17:49:30	17:57:00	17:59:00	18:06:00	18:12:30	18:20:30	18:27:00	18:29:00	18:39:00	18:47:00
17:01:00	17:09:30	17:26:00	17:28:30	17:36:00	17:44:30	17:51:30	17:59:00	18:01:00	18:08:00	18:14:30	18:22:30	18:29:00	18:31:00	18:48:00	-

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-6. Future Baseline (CBTC) Operating Plan – 6 Line – Pelham-Lexington Avenue Local

Pelham Bay Park	Parkchester	3 Avenue-138 Street	125 Street	86 Street	Grand Central - 42 Street	14 Street - Union Sq	Brooklyn Bridge	Brooklyn Bridge	14 Street - Union Sq	Grand Central - 42 Street	86 Street	125 Street	3 Avenue-138 Street	Parkchester	Pelham Bay Park
-	17:11:30	17:28:00	17:30:30	17:38:00	17:46:30	17:53:30	18:01:00	18:03:00	18:10:00	18:16:30	18:24:30	18:31:00	18:33:00	18:43:00	18:51:00
17:05:00	17:13:30	17:30:00	17:32:30	17:40:00	17:48:30	17:55:30	18:03:00	18:05:00	18:12:00	18:18:30	18:26:30	18:33:00	18:35:00	18:52:00	-
-	17:16:30	17:33:00	17:35:30	17:43:00	17:51:30	17:58:30	18:06:00	18:08:00	18:15:00	18:21:30	18:29:30	18:36:00	18:38:00	18:48:00	18:56:00
17:12:00	17:20:30	17:37:00	17:39:30	17:47:00	17:55:30	18:02:30	18:10:00	18:12:00	18:19:00	18:25:30	18:33:30	18:40:00	18:42:00	18:59:00	-
-	17:23:30	17:40:00	17:42:30	17:50:00	17:58:30	18:05:30	18:13:00	18:15:00	18:22:00	18:28:30	18:36:30	18:43:00	18:45:00	18:55:00	19:03:00
17:18:00	17:26:30	17:43:00	17:45:30	17:53:00	18:01:30	18:08:30	18:16:00	18:18:30	18:25:30	18:32:00	18:40:00	18:46:30	18:48:30	19:05:30	-
-	17:30:30	17:47:00	17:49:30	17:57:00	18:05:30	18:12:30	18:20:00	18:22:30	18:29:30	18:36:00	18:44:00	18:50:30	18:52:30	19:02:30	19:10:30
17:26:00	17:34:30	17:51:00	17:53:30	18:01:00	18:09:30	18:16:30	18:24:00	18:26:30	18:33:30	18:40:00	18:48:00	18:54:30	18:56:30	19:13:30	-
-	17:38:30	17:55:00	17:57:30	18:05:00	18:13:30	18:20:30	18:28:00	18:30:30	18:37:30	18:44:00	18:52:00	18:58:30	19:00:30	19:10:30	19:18:30
17:34:30	17:42:30	17:59:00	18:01:30	18:08:00	18:16:30	18:23:30	18:31:00	18:34:30	18:41:30	18:48:00	18:56:00	19:02:30	19:04:30	19:21:30	-
-	17:46:30	18:03:00	18:05:30	18:12:00	18:20:30	18:27:30	18:35:00	18:38:30	18:45:30	18:52:00	19:00:00	19:06:30	19:08:30	19:18:30	19:26:30
17:41:30	17:49:30	18:06:00	18:08:30	18:15:00	18:23:30	18:30:30	18:38:00	18:42:30	18:49:30	18:56:00	19:04:00	19:10:30	19:12:30	19:29:30	-
-	17:53:30	18:10:00	18:12:30	18:19:00	18:27:30	18:34:30	18:42:00	18:46:30	18:53:30	19:00:00	19:08:00	19:14:30	19:16:30	19:26:30	19:34:30
17:49:30	17:57:30	18:14:00	18:16:30	18:23:00	18:31:30	18:38:30	18:46:00	18:50:30	18:57:30	19:04:00	19:12:00	19:18:30	19:20:30	19:37:30	-
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17:57:30	18:05:30	18:22:00	18:24:30	18:31:00	18:39:30	18:46:30	18:54:00	18:58:30	19:05:30	19:11:00	19:19:00	19:25:30	19:27:30	19:44:30	-
-	18:09:30	18:26:00	18:28:30	18:35:00	18:43:30	18:50:30	18:58:00	19:02:30	19:09:30	19:15:00	19:23:00	19:29:30	19:31:30	19:41:30	19:49:30
18:05:30	18:13:30	18:30:00	18:32:30	18:39:00	18:47:30	18:54:30	19:02:00	19:06:30	19:13:30	19:19:00	19:27:00	19:33:30	19:35:30	19:52:30	-
-	18:17:30	18:34:00	18:36:30	18:43:00	18:51:30	18:58:30	19:06:00	19:10:30	19:17:30	19:23:00	19:31:00	19:37:30	19:39:30	19:49:30	19:57:30
18:13:30	18:21:30	18:38:00	18:40:30	18:47:00	18:55:30	19:02:30	19:10:00	19:14:30	19:21:30	19:27:00	19:35:00	19:41:30	19:43:30	20:00:30	-
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18:21:30	18:29:30	18:46:00	18:48:30	18:55:00	19:03:30	19:10:30	19:18:00	19:22:30	19:29:30	19:35:00	19:43:00	19:49:30	19:51:30	20:08:30	-
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18:29:30	18:37:30	18:54:00	18:56:30	19:03:00	19:11:30	19:18:30	19:26:00	19:30:30	19:37:30	19:43:00	19:51:00	19:57:30	19:59:30	20:16:30	-
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18:56:00	19:04:00	19:20:00	19:22:30	19:29:00	19:37:30	19:43:30	19:51:00	19:55:30	20:02:30	20:08:00	20:16:00	20:22:30	20:24:30	20:41:30	-
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19:05:00	19:13:00	19:29:00	19:31:30	19:38:00	19:46:30	19:52:30	20:00:00	20:04:30	20:11:30	20:17:00	20:25:00	20:31:30	20:33:30	20:50:30	20:58:30
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-	19:27:30	19:43:30	19:46:00	19:52:30	20:01:00	20:07:00	20:14:30	20:19:00	20:26:00	20:31:30	20:39:30	20:46:00	20:48:00	20:58:00	21:06:00
19:24:30	19:32:30	19:48:30	19:51:00	19:57:30	20:06:00	20:12:00	20:19:30	20:24:00	20:31:00	20:36:30	20:44:30	20:51:00	20:53:00	21:10:00	21:18:00

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-6. Future Baseline (CBTC) Operating Plan – 6 Line – Pelham-Lexington Avenue Local

Pelham Bay Park	Parkchester	3 Avenue-138 Street	125 Street	86 Street	Grand Central - 42 Street	14 Street - Union Sq	Brooklyn Bridge	Brooklyn Bridge	14 Street - Union Sq	Grand Central - 42 Street	86 Street	125 Street	3 Avenue-138 Street	Parkchester	Pelham Bay Park
-	19:37:30	19:53:30	19:56:00	20:02:30	20:11:00	20:17:00	20:24:30	20:29:00	20:36:00	20:41:30	20:49:30	20:56:00	20:58:00	21:15:00	21:23:00
19:34:30	19:42:30	19:58:30	20:01:00	20:07:30	20:16:00	20:22:00	20:29:30	20:34:00	20:41:00	20:46:30	20:54:30	21:01:00	21:03:00	21:20:00	-
-	19:47:30	20:03:30	20:06:00	20:12:30	20:21:00	20:27:00	20:34:30	20:39:00	20:46:00	20:51:30	20:59:30	21:06:00	21:08:00	21:25:00	21:33:00
19:44:30	19:52:30	20:08:30	20:11:00	20:17:30	20:26:00	20:32:00	20:39:30	20:44:00	20:51:00	20:56:30	21:04:30	21:11:00	21:13:00	21:30:00	21:38:00
-	19:57:30	20:13:30	20:16:00	20:22:30	20:31:00	20:37:00	20:44:30	20:49:00	20:56:00	21:01:30	21:09:30	21:16:00	21:18:00	21:35:00	21:43:00
19:54:30	20:02:30	20:18:30	20:21:00	20:27:30	20:36:00	20:42:00	20:49:30	20:54:00	21:01:00	21:06:30	21:14:30	21:21:00	21:23:00	21:40:00	21:48:00
-	20:07:30	20:23:30	20:26:00	20:32:30	20:41:00	20:47:00	20:54:30	20:59:00	21:06:00	21:11:30	21:19:30	21:26:00	21:28:00	21:45:00	21:53:00
20:04:30	20:12:30	20:28:30	20:31:00	20:37:30	20:46:00	20:52:00	20:59:30	21:04:00	21:11:00	21:16:30	21:24:30	21:31:00	21:33:00	21:50:00	21:58:00
-	20:17:30	20:33:30	20:36:00	20:42:30	20:51:00	20:57:00	21:04:30	21:09:00	21:16:00	21:21:30	21:29:30	21:36:00	21:38:00	21:55:00	22:03:00
20:14:30	20:22:30	20:38:30	20:41:00	20:47:30	20:56:00	21:02:00	21:09:30	21:14:00	21:21:00	21:26:30	21:34:30	21:41:00	21:43:00	22:00:00	22:08:00
-	20:27:30	20:43:30	20:46:00	20:52:30	21:01:00	21:07:00	21:14:30	21:19:00	21:26:00	21:31:30	21:39:30	21:46:00	21:48:00	22:05:00	22:13:00
20:24:30	20:32:30	20:48:30	20:51:00	20:57:30	21:06:00	21:12:00	21:19:30	21:24:00	21:31:00	21:36:30	21:44:30	21:51:00	21:53:00	22:10:00	22:18:00
-	20:37:30	20:53:30	20:56:00	21:02:30	21:11:00	21:17:00	21:24:30	21:29:00	21:36:00	21:41:30	21:49:30	21:56:00	21:58:00	22:15:00	22:23:00
20:34:30	20:42:30	20:58:30	21:01:00	21:07:30	21:16:00	21:22:00	21:29:30	21:34:00	21:41:00	21:46:30	21:54:30	22:01:00	22:03:00	22:20:00	22:28:00
-	20:48:30	21:04:30	21:07:00	21:13:30	21:22:00	21:28:00	21:35:30	21:40:00	21:47:00	21:52:30	22:00:30	22:07:00	22:09:00	22:26:00	22:34:00
20:46:30	20:54:30	21:10:30	21:13:00	21:19:30	21:28:00	21:34:00	21:41:30	21:46:00	21:53:00	21:58:30	22:06:30	22:13:00	22:15:00	22:32:00	22:40:00
-	21:00:30	21:16:30	21:19:00	21:25:30	21:34:00	21:40:00	21:47:30	21:52:00	21:59:00	22:04:30	22:12:30	22:19:00	22:21:00	22:38:00	22:46:00
20:58:30	21:06:30	21:22:30	21:25:00	21:31:30	21:40:00	21:46:00	21:53:30	21:58:00	22:05:00	22:10:30	22:18:30	22:25:00	22:27:00	22:44:00	22:52:00
-	21:13:30	21:29:30	21:32:00	21:38:30	21:47:00	21:53:00	22:00:30	22:05:00	22:12:00	22:17:30	22:25:30	22:32:00	22:34:00	22:51:00	22:59:00
21:12:30	21:20:30	21:36:30	21:39:00	21:45:30	21:54:00	22:00:00	22:07:30	22:12:00	22:19:00	22:24:30	22:32:30	22:39:00	22:41:00	22:58:00	23:06:00
-	21:27:30	21:43:30	21:46:00	21:52:30	22:01:00	22:07:00	22:14:30	22:19:00	22:26:00	22:31:30	22:39:30	22:46:00	22:48:00	23:05:00	23:13:00
21:27:00	21:35:00	21:51:00	21:53:30	22:00:00	22:08:30	22:14:30	22:22:00	22:26:30	22:33:30	22:39:00	22:47:00	22:53:30	22:55:30	23:12:30	23:20:30
21:35:00	21:43:00	21:59:00	22:01:30	22:08:00	22:16:30	22:22:30	22:30:00	22:34:30	22:41:30	22:47:00	22:55:00	23:01:30	23:03:30	23:20:30	23:28:30
21:43:00	21:51:00	22:07:00	22:09:30	22:16:00	22:24:30	22:30:30	22:38:00	22:42:30	22:49:30	22:55:00	23:03:00	23:09:30	23:11:30	23:28:30	23:36:30
21:51:00	21:59:00	22:15:00	22:17:30	22:24:00	22:32:30	22:38:30	22:46:00	22:50:30	22:57:30	23:03:00	23:11:00	23:17:30	23:19:30	23:36:30	23:44:30
21:59:00	22:07:00	22:23:00	22:25:30	22:32:00	22:40:30	22:46:30	22:54:00	22:58:30	23:05:30	23:11:00	23:19:00	23:25:30	23:27:30	23:44:30	23:52:30
22:07:00	22:15:00	22:31:00	22:33:30	22:40:00	22:48:30	22:54:30	23:02:00	23:06:30	23:13:30	23:19:00	23:27:00	23:33:30	23:35:30	23:52:30	24:00:30
22:15:00	22:23:00	22:39:00	22:41:30	22:48:00	22:56:30	23:02:30	23:10:00	23:17:00	23:24:00	23:29:30	23:37:30	23:44:00	23:46:00	24:03:00	24:11:00
22:23:00	22:31:00	22:47:00	22:49:30	22:56:00	23:04:30	23:10:30	23:18:00	23:29:00	23:36:00	23:41:30	23:49:30	23:56:00	23:58:00	24:15:00	24:23:00
22:33:00	22:41:00	22:57:00	22:59:30	23:06:00	23:14:30	23:20:30	23:28:00	23:41:00	23:48:00	23:53:30	24:01:30	24:08:00	24:10:00	24:27:00	24:35:00
22:43:00	22:51:00	23:07:00	23:09:30	23:16:00	23:24:30	23:30:30	23:38:00	23:51:00	23:58:00	24:03:30	24:11:30	24:18:00	24:20:00	24:37:00	24:45:00
22:53:00	23:01:00	23:17:00	23:19:30	23:26:00	23:34:30	23:40:30	23:48:00	24:01:00	24:08:00	24:13:30	24:21:30	24:28:00	24:30:00	24:47:00	24:55:00
23:03:00	23:11:00	23:27:00	23:29:30	23:36:00	23:44:30	23:50:30	23:58:00	24:11:00	24:18:00	24:23:30	24:31:30	24:38:00	24:40:00	24:57:00	25:05:00
23:13:00	23:21:00	23:37:00	23:39:30	23:46:00	23:54:30	24:00:30	24:08:00	24:21:00	24:28:00	24:33:30	24:41:30	24:48:00	24:50:00	25:07:00	25:15:00
23:23:00	23:31:00	23:47:00	23:49:30	23:56:00	24:04:30	24:10:30	24:18:00	24:31:00	24:38:00	24:43:30	24:51:30	24:58:00	25:00:00	25:17:00	25:25:00
23:33:00	23:41:00	23:57:00	23:59:30	24:06:00	24:14:30	24:20:30	24:28:00	24:41:00	24:48:00	24:53:30	25:01:30	25:08:00	25:10:00	25:27:00	25:35:00

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.2-6. Future Baseline (CBTC) Operating Plan – 6 Line – Pelham-Lexington Avenue Local

Pelham Bay Park	Parkchester	3 Avenue-138 Street	125 Street	86 Street	Grand Central - 42 Street	14 Street - Union Sq	Brooklyn Bridge	Brooklyn Bridge	14 Street - Union Sq	Grand Central - 42 Street	86 Street	125 Street	3 Avenue-138 Street	Parkchester	Pelham Bay Park
23:43:00	23:51:00	24:07:00	24:09:30	24:16:00	24:24:30	24:30:30	24:38:00	24:51:00	24:58:00	25:03:30	25:11:30	25:18:00	25:20:00	25:37:00	25:45:00
23:54:00	24:02:00	24:18:00	24:20:30	24:27:00	24:35:30	24:41:30	24:49:00	25:03:00	25:10:00	25:15:30	25:23:30	25:30:00	25:32:00	25:49:00	25:57:00

**APPENDICES TO FUTURE BASELINE (CBTC)
TECHNICAL MEMORANDUM**

G.3 CBTC Network Capacity and Peak Simulated Service

**APPENDICES TO FUTURE BASELINE (CBTC)
TECHNICAL MEMORANDUM**

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APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

G.3.1 CBTC Network Capacity and Morning Peak Simulated Service

Table G.3-1. CBTC Network Capacity and Morning Peak Simulated Service

Line	Track	Dir	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity ¹	Volume/ Capacity
Broadway	BB1	S	Van Cortlandt Park/242 Street	238 Street	1	15					15	26	58%
Broadway	BB4	N	238 Street	Van Cortlandt Park/ 242 Street	1	15					15	26	58%
Broadway	BB1	S	238 Street	Dyckman Street	1	25					25	36	69%
Broadway	BB4	N	Dyckman Street	238 Street	1	25					25	36	69%
Broadway	BB1	S	Dyckman Street	145 Street	1	25					25	36	69%
Broadway	BB4	N	145 Street	Dyckman Street	1	25					25	36	69%
Broadway	BB1	S	145 Street	137 Street	1	25					25	36	69%
Broadway	BB4	N	137 Street	145 Street	1	27					27	36	75%
Broadway	BB1	S	137 Street	103 Street	1	30					30	36	83%
Broadway	BB4	N	103 Street	137 Street	1	30					30	36	83%
Broadway	BB1/B1	S	103 Street	Times Sq/42 Street	1	30					30	36	83%
Broadway	B4/BB4	N	Times Sq/42 Street	103 Street	1	30					30	36	83%
7th Avenue	V1	S	Times Sq/42 Street	Chambers Street	1	30					30	36	83%
7th Avenue	V4	N	Chambers Street	Times Sq/42 Street	1	30					30	36	83%
7th Avenue	V1/V1A	S	Chambers Street	South Ferry Terminal	1	30					30	36	83%
7th Avenue	V4/V4A	N	South Ferry Terminal	Chambers Street	1	30					30	36	83%
Lenox Avenue	F1	S	Harlem/148 Street	145 Street	3	13					13	16	81%
Lenox Avenue	F4	N	145 Street	Harlem/148 Street	3	14					14	16	88%
Lenox Avenue	F1	S	145 Street	142 Street Jct	3	13					13	36	36%
Lenox Avenue	F4	N	142 Street Jct	145 Street	3	14					14	18	78%
Lenox Avenue	F2	S	142 Street Jct	Central Park North (110 Street)	2 3	27					27	36	75%
Lenox Avenue	F3	N	Central Park North (110 Street)	142 Street Jct	2 3	27					27	36	75%
Lenox Avenue	F2	S	Central Park North (110 Street)	103 Street	2 3	27					27	36	75%
Lenox Avenue	F3	N	103 Street	Central Park North (110 Street)	2 3	27					27	36	75%
Broadway	F2/B2	S	103 Street	Times Sq/42 Street	2 3	27					27	36	75%
Broadway	B3/F3	N	Times Sq/42 Street	103 Street	2 3	27					27	36	75%
7th Avenue	V2	S	Times Sq/42 Street	Chambers Street	2 3	27					27	36	75%
7th Avenue	V3	N	Chambers Street	Times Sq/42 Street	2 3	27					27	36	75%
7th Avenue	K2	S	Chambers Street	Park Pl	2 3	27					27	36	75%
7th Avenue	K3	N	Park Pl	Chambers Street	2 3	27					27	36	75%
Clark Street	K2	S	Park Pl	Fulton Street	2 3	27					27	36	75%

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.3-1. CBTC Network Capacity and Morning Peak Simulated Service

Line	Track	Dir	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity ¹	Volume/ Capacity
Clark Street	K3	N	Fulton Street	Park Pl	2 3	27					27	36	75%
Clark Street	K2	S	Fulton Street	Hoyt Street	2 3	27					27	36	75%
7th Avenue	K3	N	Hoyt Street	Fulton Street	2 3	27					27	36	75%
Eastern Parkway	E1	S	Hoyt Street	Franklin Avenue	2 3	27					27	36	75%
Eastern Parkway	E4	N	Franklin Avenue	Hoyt Street	2 3	27					27	36	75%
Eastern Parkway	E1	S	Franklin Avenue	Nostrand Jct	2 3	27					27	36	75%
Eastern Parkway	E4	N	Nostrand Jct	Franklin Avenue	2 3	27					27	36	75%
Eastern Parkway	E1	S	Nostrand Jct	Van Siclen Avenue	3	14					14	36	39%
Eastern Parkway	E4	N	Van Siclen Avenue	Nostrand Avenue	3	14					14	36	39%
Eastern Parkway	E1	S	Van Siclen Avenue	New Lots Avenue	3	14					14	23	61%
Eastern Parkway	E4	N	New Lots Avenue	Van Siclen Avenue	3	14					14	23	61%
White Plains Road	W2	S	Wakefield/241 Street	Nereid Avenue	2	13					13	21	62%
White Plains Road	W3	N	Nereid Avenue	Wakefield/241 Street	2	13					13	21	62%
White Plains Road	W2	S	Nereid Avenue	Bronx Park East	2	13	5	4			17	36	47%
White Plains Road	W3	N	Bronx Park East	Nereid Avenue	2	13					13	36	36%
White Plains Road	W2	S	Bronx Park East	E 180 Street	2	13	5	4			17	36	47%
White Plains Road	W3	N	E 180 Street	Bronx Park East	2	13					13	36	36%
Lenox Avenue/ White Plains Rd	W2	S	E 180 Street	West Farms Sq/E Tremont Avenue	2	13					13	36	36%
Lenox Avenue/ White Plains Rd	WM	S	E 180 Street	West Farms Sq/ E Tremont Avenue	5	11					11	36	31%
Lenox Avenue/ White Plains Rd	W3	N	West Farms Sq/E Tremont Avenue	E 180 Street	2	13	5	10			23	36	64%
Lenox Avenue/ White Plains Rd	F2	S	West Farms Sq/E Tremont Avenue	3 Avenue/149 Street	2	13					13	36	36%
Lenox Avenue/ White Plains Rd	FM	S	West Farms Sq/E Tremont Avenue	3 Avenue/149 Street	5	11					11	36	31%
Lenox Avenue/ White Plains Rd	F3	N	3 Avenue/149 Street	West Farms Sq/E Tremont Avenue	2	13	5	10			23	36	64%
Lenox Avenue	F2	S	3 Avenue/149 Street	149 Street/Grand Concourse	2	13	5	11			24	24	100%
Lenox Avenue	F3	N	149 Street/Grand Concourse	3 Avenue/149 Street	2	13	5	10			23	24	96%
Lenox Avenue	F2	S	149 Street/Grand Concourse	142 Street Jct	2	13					13	18	72%
Lenox Avenue	F3	N	142 Street Jct	149 Street/Grand Concourse	2	13					13	18	72%
Eastern Parkway	E1	S	Nostrand Jct	Nostrand Jct	2 3	27	5	10			37	36	103%
Eastern Parkway	E4	N	Nostrand Jct	Nostrand Jct	2	13	3	14	5	10	37	36	103%

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.3-1. CBTC Network Capacity and Morning Peak Simulated Service

Line	Track	Dir	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity ¹	Volume/ Capacity
Nostrand Avenue	D2	S	Nostrand Jct	Newkirk Avenue	2	13	5	10			23	23	100%
Nostrand Avenue	D3	N	Newkirk Avenue	Nostrand Jct	2	13	5	10			23	23	100%
Nostrand Avenue	D2	S	Newkirk Avenue	Flatbush Avenue/Brooklyn College	2	13	5	10			23	31	74%
Nostrand Avenue	D3	N	Flatbush Avenue/Brooklyn College	Newkirk Avenue	2	13	5	10			23	31	74%
Jerome Avenue	J1	S	Woodlawn	Mosholu Pkwy	4	21					21	26	81%
Jerome Avenue	J4	N	Mosholu Pkwy	Woodlawn	4	21					21	26	81%
Jerome Avenue	J1	S	Mosholu Pkwy	Bedford Park Blvd/Lehman College	4	21					21	26	81%
Jerome Avenue	J4	N	Bedford Park Blvd/Lehman College	Mosholu Pkwy	4	21					21	26	81%
Jerome Avenue	J1	S	Bedford Park Blvd/Lehman College	149 Street/Grand Concourse	4	21					21	36	58%
Jerome Avenue	J4	N	149 Street/Grand Concourse	Bedford Park Blvd/Lehman College	4	21					21	36	58%
Jerome Avenue	J1	S	149 Street/Grand Concourse	138 Street/Grand Concourse	4	21					21	36	58%
Jerome Avenue	J4	N	North of 138 Street	149 Street/Grand Concourse	4	21					21	36	58%
Lexington Avenue	J4	N	138 Street/Grand Concourse	North of 138 Street	4 5	30					30	36	83%
Lexington Avenue	L3	N	125 Street	138 Street/Grand Concourse	4 5	30					30	36	83%
Lexington Avenue	L2	S	116 Street	110 Street	4 5	30					30	36	83%
Lexington Avenue	L2	S	110 Street	103 Street	4 5	30					30	36	83%
Lexington Avenue	L2	S	103 Street	51 Street	4 5	30					30	36	83%
Lexington Avenue	L3	N	51 Street	125 Street	4 5	30					30	36	83%
Lexington Avenue	E2	S	51 Street	Grand Central/42 Street	4 5	30					30	36	83%
Lexington Avenue	MM2	S	Grand Central/42 Street	14 Street/Union Sq	4 5	30					30	30	100%
Lexington Avenue	L3	N	Grand Central/42 Street	51 Street	4 5	30					30	30	100%
Lexington Avenue	MM2	S	14 Street/Union Sq	Brooklyn Bridge	4 5	30					30	30	100%
Lexington Avenue	MM3	N	14 Street/Union Sq	Grand Central/42 Street	4 5	30					30	30	100%
Lexington Avenue	M2	S	Brooklyn Bridge	Bowling Green	4 5	30					30	36	83%
Lexington Avenue	MM3	N	Brooklyn Bridge	14 Street/Union Sq	4 5	30					30	30	100%
Lexington Avenue	M3	N	Bowling Green	Brooklyn Bridge	4 5	30					30	36	83%
Lexington Avenue	M2	S	Bowling Green	Hoyt Street	4 5	30					30	36	83%
Eastern Parkway	M3	N	Hoyt Street	Bowling Green	4 5	30					30	36	83%
Eastern Parkway	E2	S	Hoyt Street	Franklin Avenue	4 5	30					30	36	83%
Eastern Parkway	E3	N	Franklin Avenue	Hoyt Street	4 5	30					30	36	83%
Eastern Parkway	E2	S	Franklin Avenue	Nostrand Jct	4 5	30					30	36	83%
Eastern Parkway	E3	N	Nostrand Jct	Franklin Avenue	4 5	30					30	36	83%

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.3-1. CBTC Network Capacity and Morning Peak Simulated Service

Line	Track	Dir	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity ¹	Volume/ Capacity
Eastern Parkway	E2	S	Nostrand Jct	Nostrand Avenue	4	20					20	36	56%
Eastern Parkway	E3	N	Nostrand Avenue	Nostrand Jct	4	20					20	36	56%
Eastern Parkway	E2	S	Nostrand Avenue	Crown Hts/Utica Avenue	4	20					20	27	74%
Eastern Parkway	E3	N	Crown Hts/Utica Avenue	Kingston Avenue	4	20					20	27	74%
Dyre Avenue	Y1	S	Eastchester/Dyre Avenue	Baychester Avenue	5	8					8	29	28%
Dyre Avenue	Y2	N	Baychester Avenue	Eastchester/Dyre Avenue	5	10					10	29	34%
Dyre Avenue	Y1	S	Baychester Avenue	Morris Park	5	8					8	36	22%
Dyre Avenue	Y2	N	Morris Park	Baychester Avenue	5	10					10	36	28%
Dyre Avenue	Y1	S	Morris Park	E 180 Street	5	8					8	36	22%
Dyre Avenue	Y2	N	E 180 Street	Morris Park	5	10					10	36	28%
Dyre Avenue	J1A	S	149 Street/ Grand Concourse	North of 138 Street	5	11					11	18	61%
Dyre Avenue	J4A	N	138 Street/Grand Concourse	149 Street/Grand Concourse	5	10					10	18	56%
Lexington Avenue	J1	S	North of 138 Street	138 Street/Grand Concourse	5	11					11	18	61%
Pelham	P2	S	Pelham Bay Park	Westchester Sq/E Tremont Avenue	5	17					17	28	61%
Pelham	P3	N	Westchester Sq/E Tremont Avenue	Pelham Bay Park	6	15					15	28	54%
Pelham	P2	S	Westchester Sq/E Tremont Avenue	Castle Hill Avenue	6	17					17	36	47%
Pelham	P3	N	Castle Hill Avenue	Westchester Sq/E Tremont Avenue	6	30					30	36	83%
Pelham	PM	S	Westchester Sq/ E Tremont Avenue	Castle Hill Avenue	6	13					13	36	36%
Pelham	P2	S	Castle Hill Avenue	Brook Avenue	6	15					15	36	42%
Pelham	P3	N	Brook Avenue	Castle Hill Avenue	6	30					30	36	83%
Pelham	PM	S	Castle Hill Avenue	Brook Avenue	6	15					15	36	42%
Pelham	P2	S	Brook Avenue	3 Avenue/138 Street	6	15					15	36	42%
Pelham	P3	N	3 Avenue/138 Street	Brook Avenue	6	30					30	36	83%
Pelham	PM	S	Brook Avenue	3 Avenue/138 Street	6	15					15	36	42%
Lexington Avenue	L2	S	3 Avenue/138 Street	125 Street	6	30					30	36	83%
Lexington Avenue	L3A	N	125 Street	3 Avenue/138 Street	6	30					30	36	83%
Lexington Avenue	L1	S	125 Street	116 Street	6	30					30	36	83%
Lexington Avenue	L1	S	116 Street	51 Street	6	30					30	36	83%
Lexington Avenue	L4	N	51 Street	125 Street	6	30					30	36	83%
Lexington Avenue	L1	S	51 Street	Grand Central/42 Street	6	30					30	36	83%
Lexington Avenue	L4	N	Grand Central/42 Street	51 Street	6	30					30	36	83%
Lexington Avenue	L1	S	Grand Central/42 Street	Grand Central South Interlocking	6	30					30	36	83%

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.3-1. CBTC Network Capacity and Morning Peak Simulated Service

Line	Track	Dir	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity ¹	Volume/ Capacity
Lexington Avenue	MM4	N	14 Street/Union Sq	Grand Central/42 Street	6	30					30	36	83%
Lexington Avenue	MM1	S	Grand Central South Interlocking	14 Street/Union Sq	6	30					30	36	83%
Lexington Avenue	MM1	S	14 Street/Union Sq	Brooklyn Bridge	6	30					30	36	83%
Lexington Avenue	MM4	N	Brooklyn Bridge	14 Street/Union Sq	6	30					30	36	83%
Lexington Avenue	ML	S	Brooklyn Bridge South	Brooklyn Bridge North	6	30					30	30	100%
42nd Street Shuttle ²	MMS1	S/N	Times Sq Shuttle	Grand Central Shuttle	S	10					10	10	100%
42nd Street Shuttle ²	MMS4	S/N	Times Sq Shuttle	Grand Central Shuttle	S	10					10	10	100%

Note:

1. Capacity is shown on a segment-specific basis. Available capacity may not be usable given constraints elsewhere in the network for a given service.
2. Times Sq-Grand Central service delivery and capacity reflect one-way operation. Bidirectional service delivery on each track is double the train volumes shown.

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

G.3.2 CBTC Network Capacity and Evening Peak Simulated Service

Table G.3-2. CBTC Network Capacity and Evening Peak Simulated Service

Line	Track	Dir	From Station	To Station	Service ¹	TPH	Service ²	TPH	Service ³	TPH	Total TPH	Capacity ¹	Volume/ Capacity
Broadway	BB1	S	Van Cortlandt Park/242 Street	238 Street	1	18					18	26	69%
Broadway	BB4	N	238 Street	Van Cortlandt Park/ 242 Street	1	18					18	26	69%
Broadway	BB1	S	238 Street	Dyckman Street	1	26					26	36	72%
Broadway	BB4	N	Dyckman Street	238 Street	1	26					26	36	72%
Broadway	BB1	S	Dyckman Street	145 Street	1	26					26	36	72%
Broadway	BB4	N	145 Street	Dyckman Street	1	26					26	36	72%
Broadway	BB1	S	145 Street	137 Street	1	26					26	36	72%
Broadway	BB4	N	137 Street	145 Street	1	26					26	36	72%
Broadway	BB1	S	137 Street	103 Street	1	30					30	36	83%
Broadway	BB4	N	103 Street	137 Street	1	30					30	36	83%
Broadway	BB1/B1	S	103 Street	Times Sq/42 Street	1	30					30	36	83%
Broadway	B4/BB4	N	Times Sq/42 Street	103 Street	1	30					30	36	83%
7th Avenue	V1	S	Times Sq/42 Street	Chambers Street	1	30					30	36	83%
7th Avenue	V4	N	Chambers Street	Times Sq/42 Street	1	30					30	36	83%
7th Avenue	V1/V1A	S	Chambers Street	South Ferry Terminal	1	30					30	36	83%
7th Avenue	V4/V4A	N	South Ferry Terminal	Chambers Street	1	30					30	36	83%
Lenox Avenue	F1	S	Harlem/148 Street	145 Street	3	13					13	16	81%
Lenox Avenue	F4	N	145 Street	Harlem/148 Street	3	13					13	16	81%
Lenox Avenue	F1	S	145 Street	142 Street Jct	3	13					13	36	36%
Lenox Avenue	F4	N	142 Street Jct	145 Street	3	13					13	18	72%
Lenox Avenue	F2	S	142 Street Jct	Central Park North (110 Street)	2 3	26					26	36	72%
Lenox Avenue	F3	N	Central Park North (110 Street)	142 Street Jct	2 3	26					26	36	72%
Lenox Avenue	F2	S	Central Park North (110 Street)	103 Street	2 3	26					26	36	72%
Lenox Avenue	F3	N	103 Street	Central Park North (110 Street)	2 3	26					26	36	72%
Broadway	F2/B2	S	103 Street	Times Sq/42 Street	2 3	26					26	36	72%
Broadway	B3/F3	N	Times Sq/42 Street	103 Street	2 3	26					26	36	72%
7th Avenue	V2	S	Times Sq/42 Street	Chambers Street	2 3	26					26	36	72%
7th Avenue	V3	N	Chambers Street	Times Sq/42 Street	2 3	26					26	36	72%
7th Avenue	K2	S	Chambers Street	Park Street	2 3	26					26	36	72%
7th Avenue	K3	N	Park Street	Chambers Street	2 3	26					26	36	72%
Clark Street	K2	S	Park Street	Fulton Street	2 3	26					26	36	72%

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.3-2. CBTC Network Capacity and Evening Peak Simulated Service

Line	Track	Dir	From Station	To Station	Service ¹	TPH	Service ²	TPH	Service ³	TPH	Total TPH	Capacity ¹	Volume/ Capacity
Clark Street	K3	N	Fulton Street	Park Street	2 3	26					26	36	72%
Clark Street	K2	S	Fulton Street	Hoyt Street	2 3	26					26	36	72%
7th Avenue	K3	N	Hoyt Street	Fulton Street	2 3	26					26	36	72%
Eastern Parkway	E1	S	Hoyt Street	Franklin Avenue	2 3	26					26	36	72%
Eastern Parkway	E4	N	Franklin Avenue	Hoyt Street	2 3	26					26	36	72%
Eastern Parkway	E1	S	Franklin Avenue	Nostrand Jct	2 3	26					26	36	72%
Eastern Parkway	E4	N	Nostrand Jct	Franklin Avenue	2 3	26					26	36	72%
Eastern Parkway	E1	S	Nostrand Jct	Van Siclen Avenue	3	13					13	36	36%
Eastern Parkway	E4	N	Van Siclen Avenue	Nostrand Avenue	3	13					13	36	36%
Eastern Parkway	E1	S	Van Siclen Avenue	New Lots Avenue	3	13					13	23	57%
Eastern Parkway	E4	N	New Lots Avenue	Van Siclen Avenue	3	13					13	23	57%
White Plains Road	W2	S	Wakefield/241 Street	Nereid Avenue	2	13					13	21	62%
White Plains Road	W3	N	Nereid Avenue	Wakefield/241 Street	2	13					13	21	62%
White Plains Road	W2	S	Nereid Avenue	Bronx Park East	2	13					13	36	36%
White Plains Road	W3	N	Bronx Park East	Nereid Avenue	2	13	5	4			17	36	47%
White Plains Road	W2	S	Bronx Park East	E 180 Street	2	13					13	36	36%
White Plains Road	W3	N	E 180 Street	Bronx Park East	2	13	5	4			17	36	47%
Lenox Avenue/ White Plains Rd	W2	S	E 180 Street	West Farms Sq/E Tremont Avenue	2	13	5	10			23	36	64%
Lenox Avenue/ White Plains Rd	WM	N	West Farms Sq/E Tremont Avenue	E 180 Street	5	12					12	36	33%
Lenox Avenue/ White Plains Rd	W3	N	West Farms Sq/E Tremont Avenue	E 180 Street	2	13					13	36	36%
Lenox Avenue/ White Plains Rd	F2	S	West Farms Sq/E Tremont Avenue	3 Avenue/149 Street	2	13	5	10			23	36	64%
Lenox Avenue/ White Plains Rd	FM	N	3 Avenue/149 Street	West Farms Sq/E Tremont Avenue	5	12					12	36	33%
Lenox Avenue/ White Plains Rd	F3	N	3 Avenue/149 Street	West Farms Sq/E Tremont Avenue	2	13					13	36	36%
Lenox Avenue	F2	S	3 Avenue/149 Street	149 Street/Grand Concourse	2	13	5	10			23	24	96%
Lenox Avenue	F3	N	149 Street/Grand Concourse	3 Avenue/149 Street	2	13					13	24	54%
Lenox Avenue	F2	S	149 Street/Grand Concourse	142 Street Jct	2	13					13	18	72%
Lenox Avenue	F3	N	142 Street Jct	149 Street/Grand Concourse	2	13					13	18	72%
Eastern Parkway	E1	S	Nostrand Jct	Nostrand Jct	2 3	26	5	10			36	36	100%
Eastern Parkway	E4	N	Nostrand Jct	Nostrand Jct	2	13	3	13	5	10	36	36	100%

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.3-2. CBTC Network Capacity and Evening Peak Simulated Service

Line	Track	Dir	From Station	To Station	Service ¹	TPH	Service ²	TPH	Service ³	TPH	Total TPH	Capacity ¹	Volume/ Capacity
Nostrand Avenue	D2	S	Nostrand Jct	Newkirk Avenue	2	13	5	10			23	23	100%
Nostrand Avenue	D3	N	Newkirk Avenue	Nostrand Jct	2	13	5	10			23	23	100%
Nostrand Avenue	D2	S	Newkirk Avenue	Flatbush Avenue/Brooklyn College	2	13	5	10			23	31	74%
Nostrand Avenue	D3	N	Flatbush Avenue/Brooklyn College	Newkirk Avenue	2	13	5	10			23	31	74%
Jerome Avenue	J1	S	Woodlawn	Mosholu Pkwy	4	20					20	26	77%
Jerome Avenue	J4	N	Mosholu Pkwy	Woodlawn	4	20					20	26	77%
Jerome Avenue	J1	S	Mosholu Pkwy	Bedford Park Blvd/Lehman College	4	20					20	26	77%
Jerome Avenue	J4	N	Bedford Park Blvd/Lehman College	Mosholu Pkwy	4	20					20	26	77%
Jerome Avenue	J1	S	Bedford Park Blvd/Lehman College	149 Street/Grand Concourse	4	20					20	36	56%
Jerome Avenue	J4	N	149 Street/Grand Concourse	Bedford Park Blvd/Lehman College	4	20					20	36	56%
Jerome Avenue	J1	S	149 Street/Grand Concourse	138 Street/Grand Concourse	4	20					20	36	56%
Jerome Avenue	J4	N	North of 138 Street	149 Street/Grand Concourse	4	20					20	36	56%
Lexington Avenue	J4	N	138 Street/Grand Concourse	North of 138 Street	4 5	30					30	36	83%
Lexington Avenue	L3	N	125 Street	138 Street/Grand Concourse	4 5	30					30	36	83%
Lexington Avenue	L2	S	116 Street	110 Street	4 5	30					30	36	83%
Lexington Avenue	L2	S	110 Street	103 Street	4 5	30					30	36	83%
Lexington Avenue	L2	S	103 Street	51 Street	4 5	30					30	36	83%
Lexington Avenue	L3	N	51 Street	125 Street	4 5	30					30	36	83%
Lexington Avenue	E2	S	51 Street	Grand Central/42 Street	4 5	30					30	36	83%
Lexington Avenue	MM2	S	Grand Central/42 Street	14 Street/Union Sq	4 5	30					30	30	100%
Lexington Avenue	L3	N	Grand Central/42 Street	51 Street	4 5	30					30	30	100%
Lexington Avenue	MM2	S	14 Street/Union Sq	Brooklyn Bridge	4 5	30					30	30	100%
Lexington Avenue	MM3	N	14 Street/Union Sq	Grand Central/42 Street	4 5	30					30	30	100%
Lexington Avenue	M2	S	Brooklyn Bridge	Bowling Green	4 5	30					30	36	83%
Lexington Avenue	MM3	N	Brooklyn Bridge	14 Street/Union Sq	4 5	30					30	30	100%
Lexington Avenue	M3	N	Bowling Green	Brooklyn Bridge	4 5	30					30	36	83%
Lexington Avenue	M2	S	Bowling Green	Hoyt Street	4 5	30					30	36	83%
Eastern Parkway	M3	N	Hoyt Street	Bowling Green	4 5	30					30	36	83%
Eastern Parkway	E2	S	Hoyt Street	Franklin Avenue	4 5	30					30	36	83%
Eastern Parkway	E3	N	Franklin Avenue	Hoyt Street	4 5	30					30	36	83%
Eastern Parkway	E2	S	Franklin Avenue	Nostrand Jct	4 5	30					30	36	83%
Eastern Parkway	E3	N	Nostrand Jct	Franklin Avenue	4 5	30					30	36	83%
Eastern Parkway	E2	S	Nostrand Jct	Nostrand Avenue	4	20					20	36	56%

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.3-2. CBTC Network Capacity and Evening Peak Simulated Service

Line	Track	Dir	From Station	To Station	Service ¹	TPH	Service ²	TPH	Service ³	TPH	Total TPH	Capacity ¹	Volume/ Capacity
Eastern Parkway	E3	N	Nostrand Avenue	Nostrand Jct	4	20					20	36	56%
Eastern Parkway	E2	S	Nostrand Avenue	Crown Hts/Utica Avenue	4	20					20	27	74%
Eastern Parkway	E3	N	Crown Hts/Utica Avenue	Kingston Avenue	4	20					20	27	74%
Dyre Avenue	Y1	S	Eastchester/Dyre Avenue	Baychester Avenue	5	10					10	29	34%
Dyre Avenue	Y2	N	Baychester Avenue	Eastchester/Dyre Avenue	5	8					8	29	28%
Dyre Avenue	Y1	S	Baychester Avenue	Morris Park	5	10					10	36	28%
Dyre Avenue	Y2	N	Morris Park	Baychester Avenue	5	8					8	36	22%
Dyre Avenue	Y1	S	Morris Park	E 180 Street	5	10					10	36	28%
Dyre Avenue	Y2	N	E 180 Street	Morris Park	5	8					8	36	22%
Dyre Avenue	J1A	S	149 Street/ Grand Concourse	North of 138 Street	5	10					10	18	56%
Dyre Avenue	J4A	N	138 Street/Grand Concourse	149 Street/Grand Concourse	5	12					12	18	67%
Lexington Avenue	J1	S	North of 138 Street	138 Street/Grand Concourse	5	10					10	18	56%
Pelham	P2	S	Pelham Bay Park	Westchester Sq/ E Tremont Av	6	15					15	28	54%
Pelham	P3	N	Westchester Sq/E Tremont Av	Pelham Bay Park	6	15					15	28	54%
Pelham	P2	S	Westchester Sq/E Tremont Av	Castle Hill Avenue	6	30					30	36	83%
Pelham	P3	N	Castle Hill Avenue	Westchester Sq/E Tremont Av	6	15					15	36	42%
Pelham	PM	N	Castle Hill Avenue	Westchester Sq/E Tremont Av	6	15					15	36	42%
Pelham	P2	S	Castle Hill Avenue	Brook Avenue	6	30					30	36	83%
Pelham	P3	N	Brook Avenue	Castle Hill Avenue	6	15					15	36	42%
Pelham	PM	N	Brook Avenue	Castle Hill Avenue	6	15					15	36	42%
Pelham	P2	S	Brook Avenue	3 Avenue/138 Street	6	30					30	36	83%
Pelham	P3	N	3 Avenue/138 Street	Brook Avenue	6	15					15	36	42%
Pelham	PM	N	3 Avenue/138 Street	Brook Avenue	6	15					15	36	42%
Lexington Avenue	L2	S	3 Avenue/138 Street	125 Street	6	30					30	36	83%
Lexington Avenue	L3A	N	125 Street	3 Avenue/138 Street	6	30					30	36	83%
Lexington Avenue	L1	S	125 Street	116 Street	6	30					30	36	83%
Lexington Avenue	L1	S	116 Street	51 Street	6	30					30	36	83%
Lexington Avenue	L4	N	51 Street	125 Street	6	30					30	36	83%
Lexington Avenue	L1	S	51 Street	Grand Central/42 Street	6	30					30	36	83%
Lexington Avenue	L4	N	Grand Central/42 Street	51 Street	6	30					30	36	83%
Lexington Avenue	L1	S	Grand Central/42 Street	Grand Central South Interlocking	6	30					30	36	83%
Lexington Avenue	MM4	N	14 Street/Union Sq	Grand Central/42 Street	6	30					30	36	83%
Lexington Avenue	MM1	S	Grand Central South Interlocking	14 Street/Union Sq	6	30					30	36	83%

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.3-2. CBTC Network Capacity and Evening Peak Simulated Service

Line	Track	Dir	From Station	To Station	Service ¹	TPH	Service ²	TPH	Service ³	TPH	Total TPH	Capacity ¹	Volume/ Capacity
Lexington Avenue	MM1	S	14 Street/Union Sq	Brooklyn Bridge	6	30					30	36	83%
Lexington Avenue	MM4	N	Brooklyn Bridge	14 Street/Union Sq	6	30					30	36	83%
Lexington Avenue	ML	S	Brooklyn Bridge South	Brooklyn Bridge North	6	30					30	30	100%
42nd Street Shuttle ²	MMS1	S/N	Times Sq Shuttle	Grand Central Shuttle	S	10					10	10	100%
42nd Street Shuttle ²	MMS4	S/N	Times Sq Shuttle	Grand Central Shuttle	S	10					10	10	100%

- Note:
1. Capacity is shown on a segment-specific basis. Available capacity may not be usable given constraints elsewhere in the network for a given service.
 2. Times Sq-Grand Central service delivery and capacity reflect one-way operation. Bidirectional service delivery on each track is double the train volumes shown.

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**APPENDICES TO FUTURE BASELINE (CBTC)
TECHNICAL MEMORANDUM**

G.4 Future Baseline (CBTC) Time-Distance (“String”) Charts

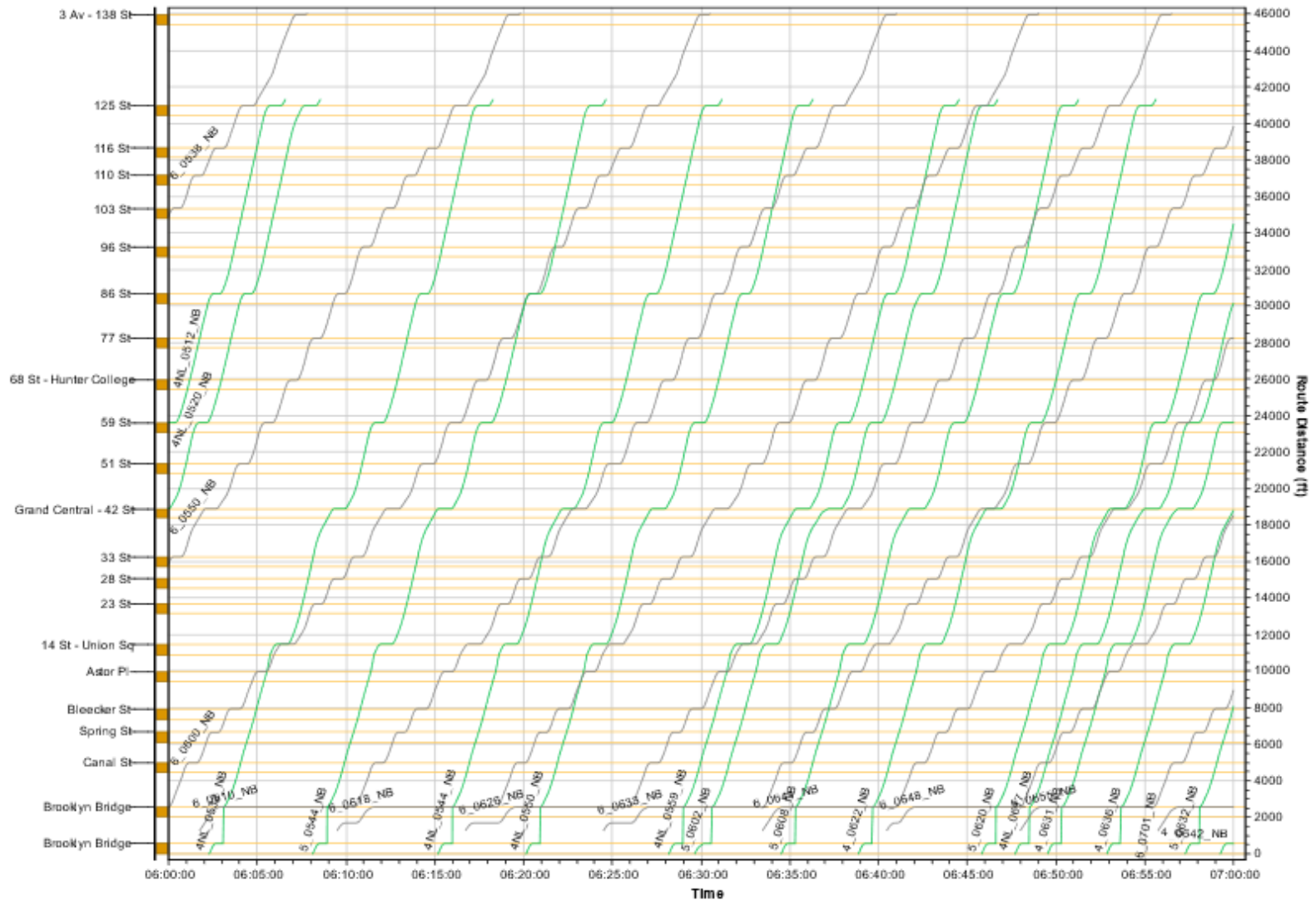
**APPENDICES TO FUTURE BASELINE (CBTC)
TECHNICAL MEMORANDUM**

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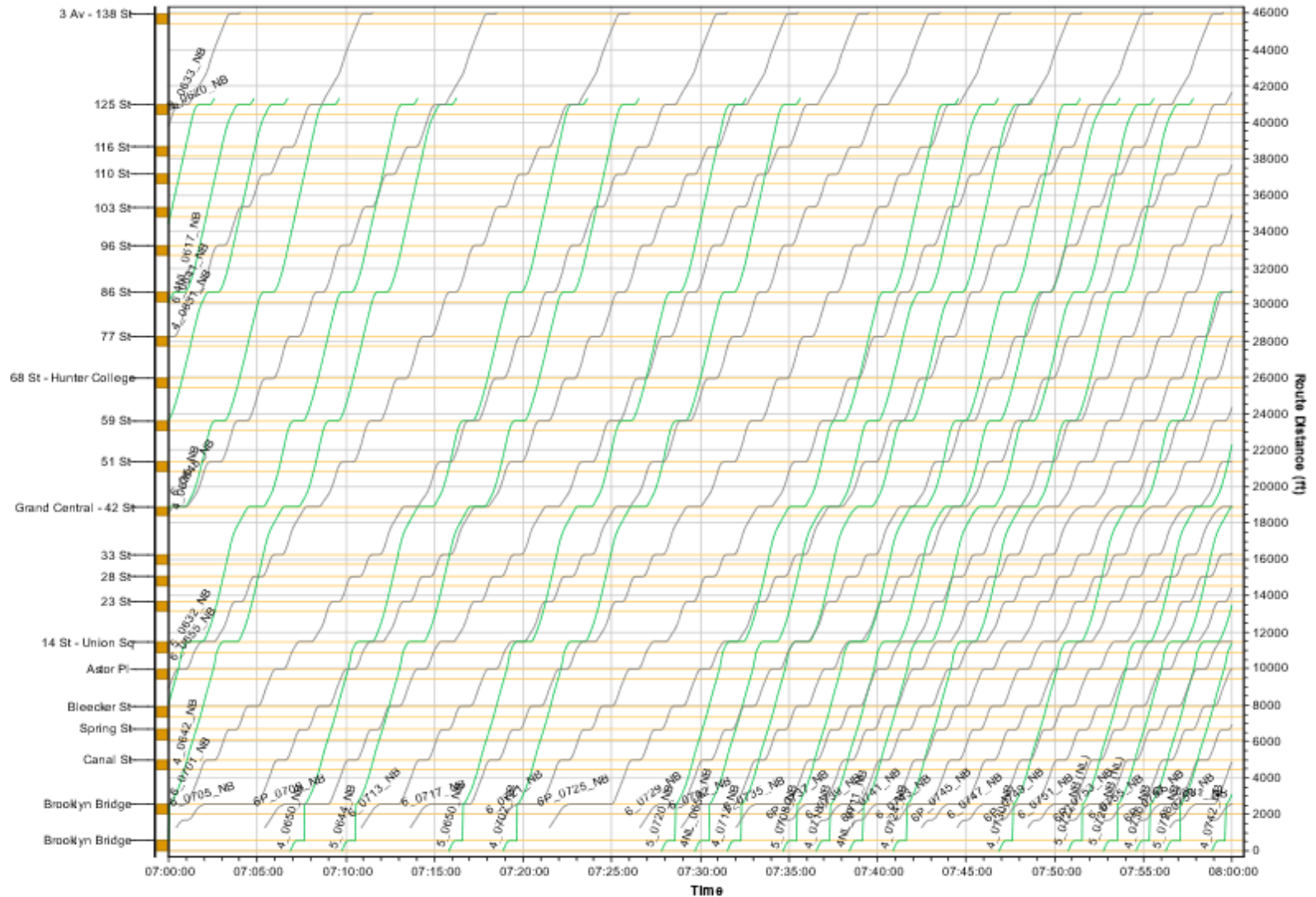
G.4.1 138 Street to Brooklyn Bridge

Figure G.4-1: Future Baseline (CBTC) String Chart - Brooklyn Bridge to 138 Street - Northbound - 6:00 to 7:00 a.m.



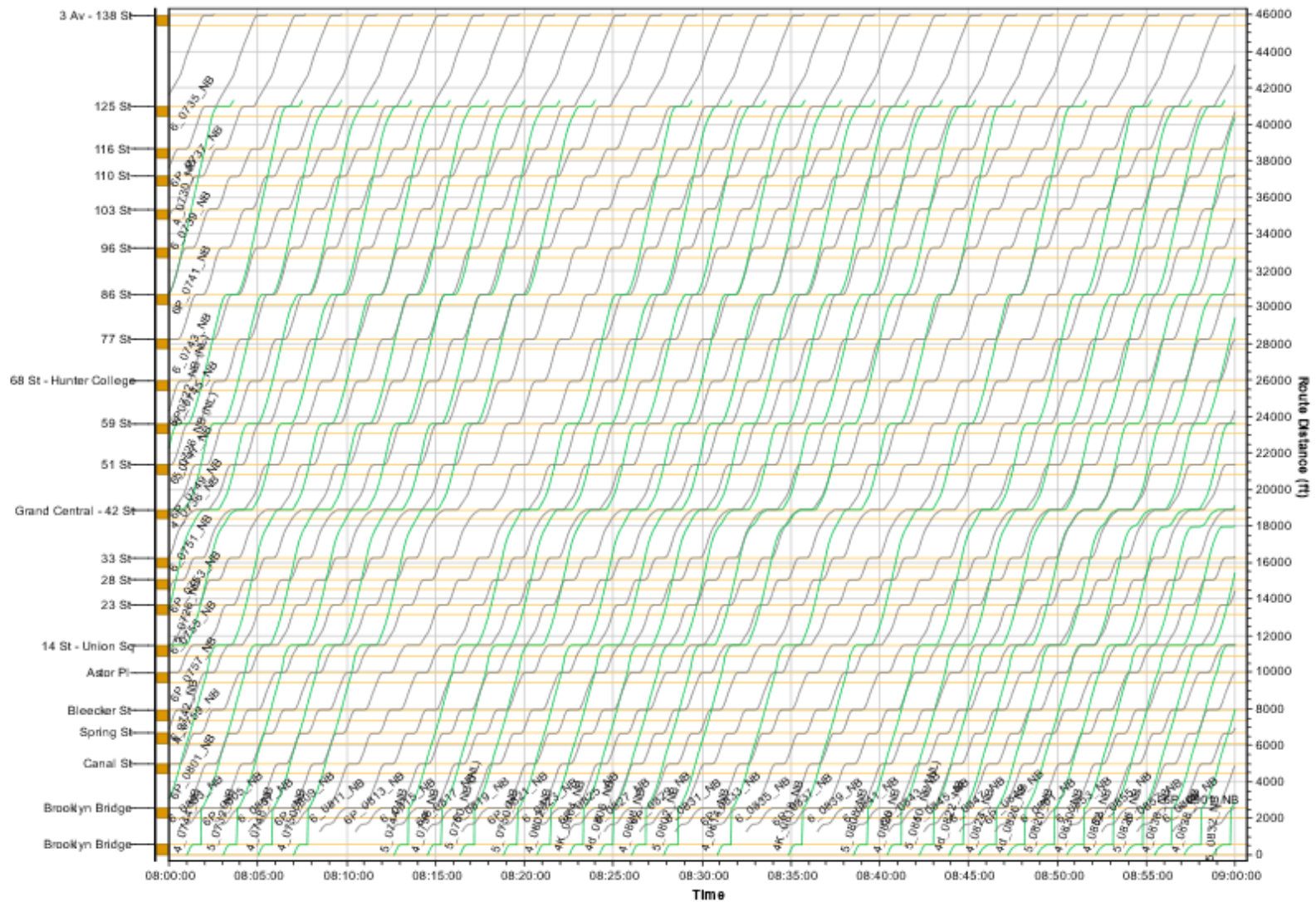
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-2: Future Baseline (CBTC) String Chart – Brooklyn Bridge to 138 Street - Northbound - 7:00 to 8:00 a.m.



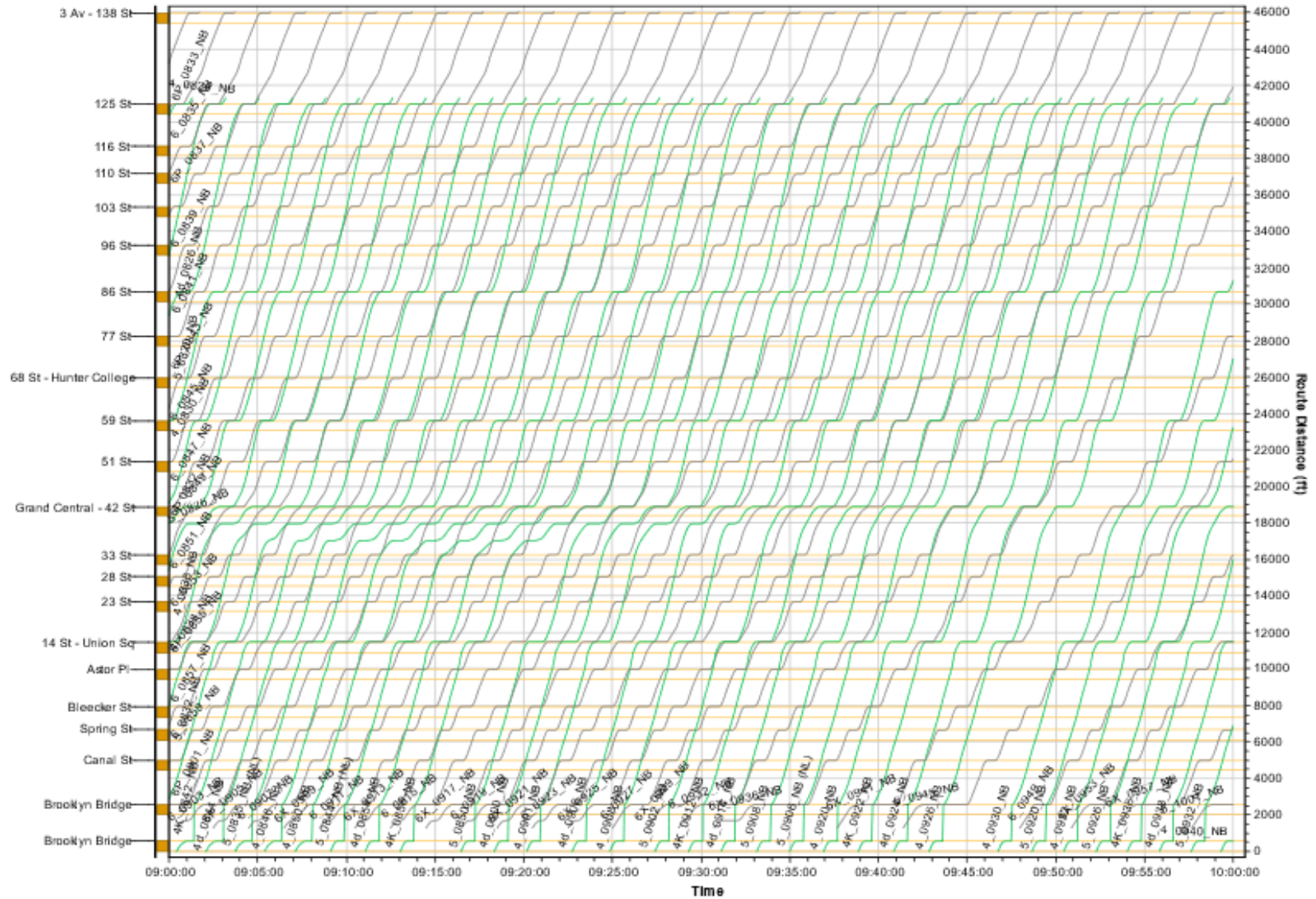
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Figure G.4-3: Future Baseline (CBTC) String Chart – Brooklyn Bridge to 138 Street - Northbound - 8:00 to 9:00 a.m.



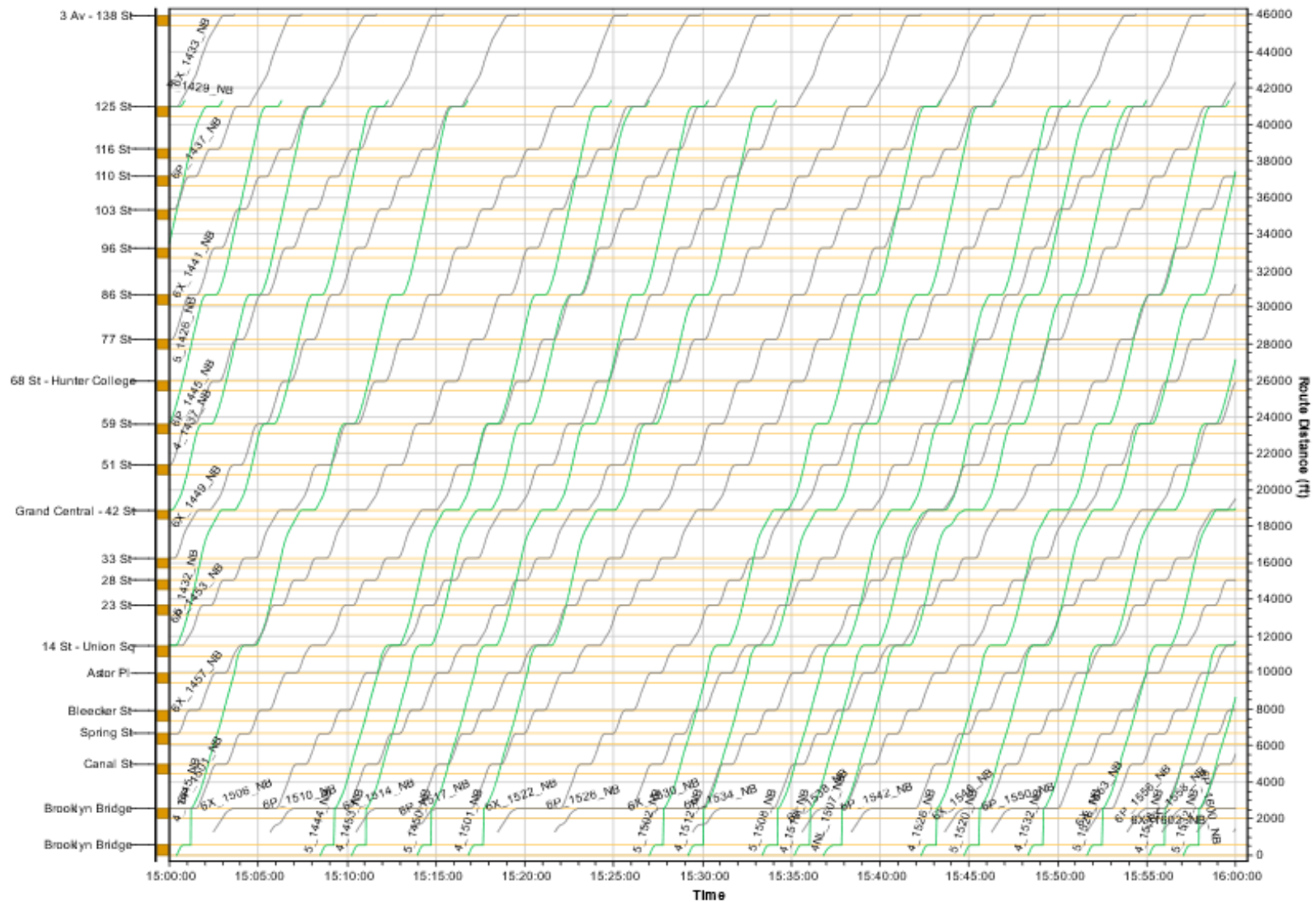
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Figure G.4-4: Future Baseline (CBTC) String Chart - Brooklyn Bridge to 138 Street - Northbound - 9:00 to 10:00 a.m.



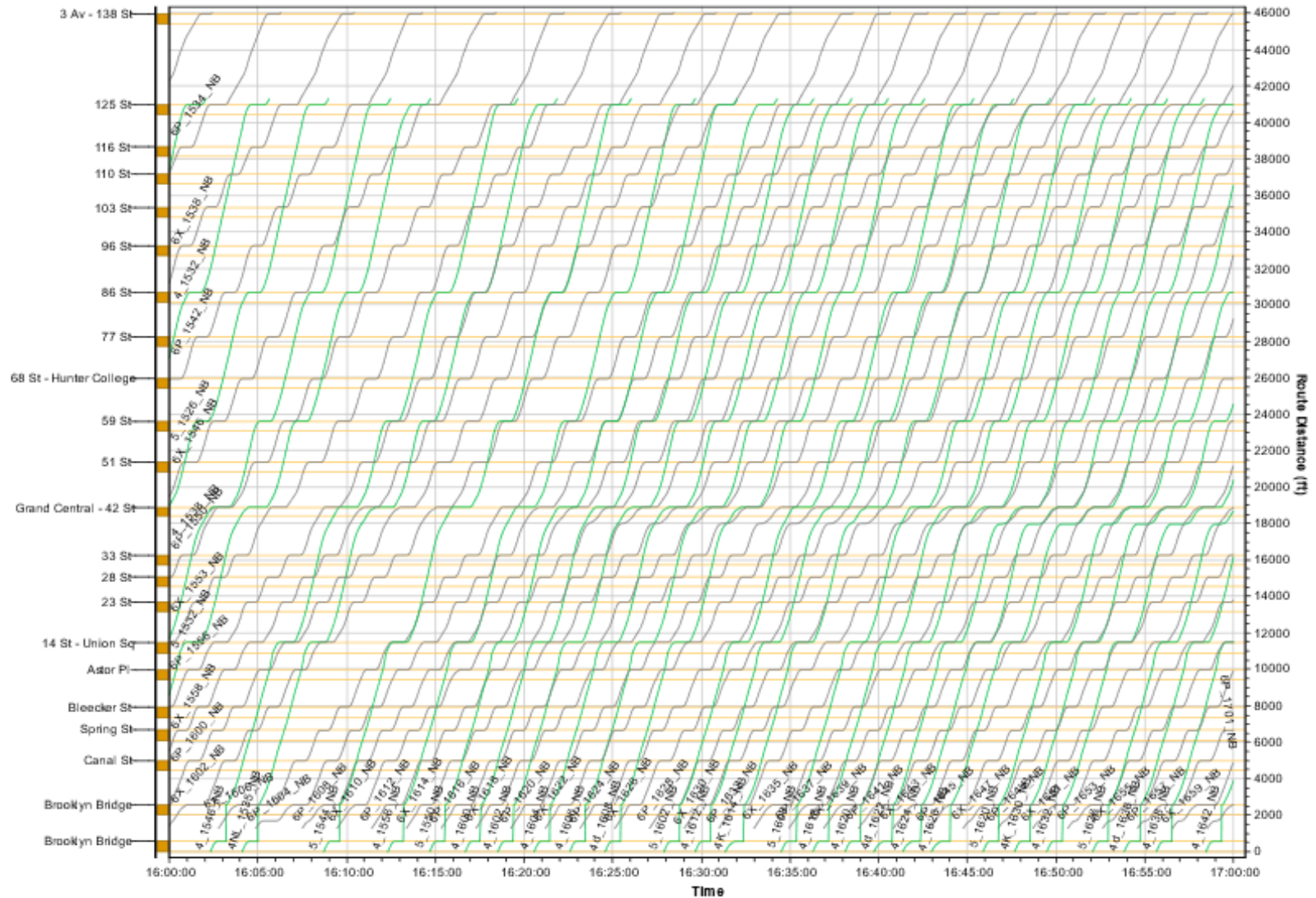
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-5: Future Baseline (CBTC) String Chart - Brooklyn Bridge to 138 Street - Northbound - 3:00 to 4:00 p.m.



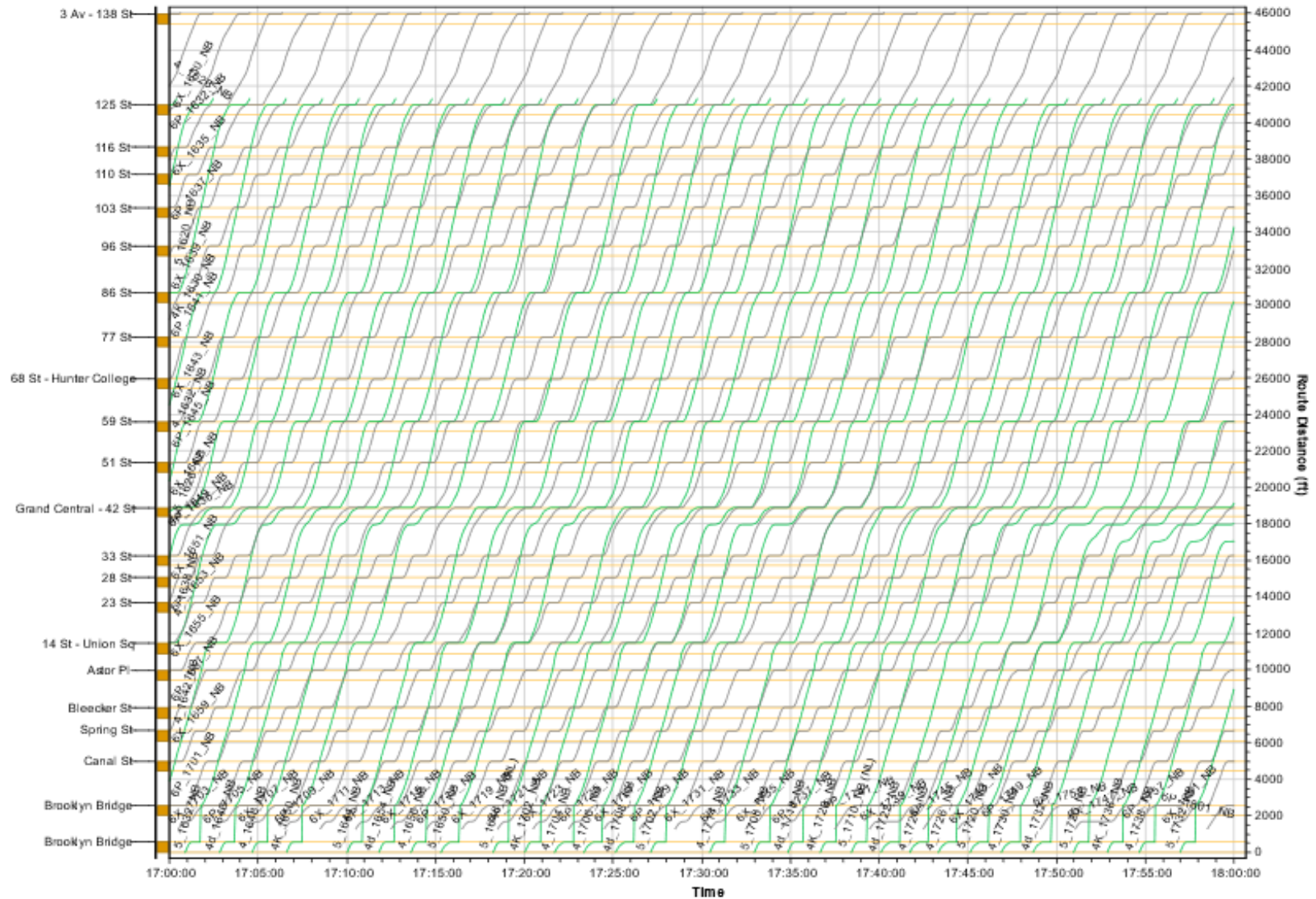
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Figure G.4-6: Future Baseline (CBTC) String Chart - Brooklyn Bridge to 138 Street - Northbound - 4:00 to 5:00 p.m.



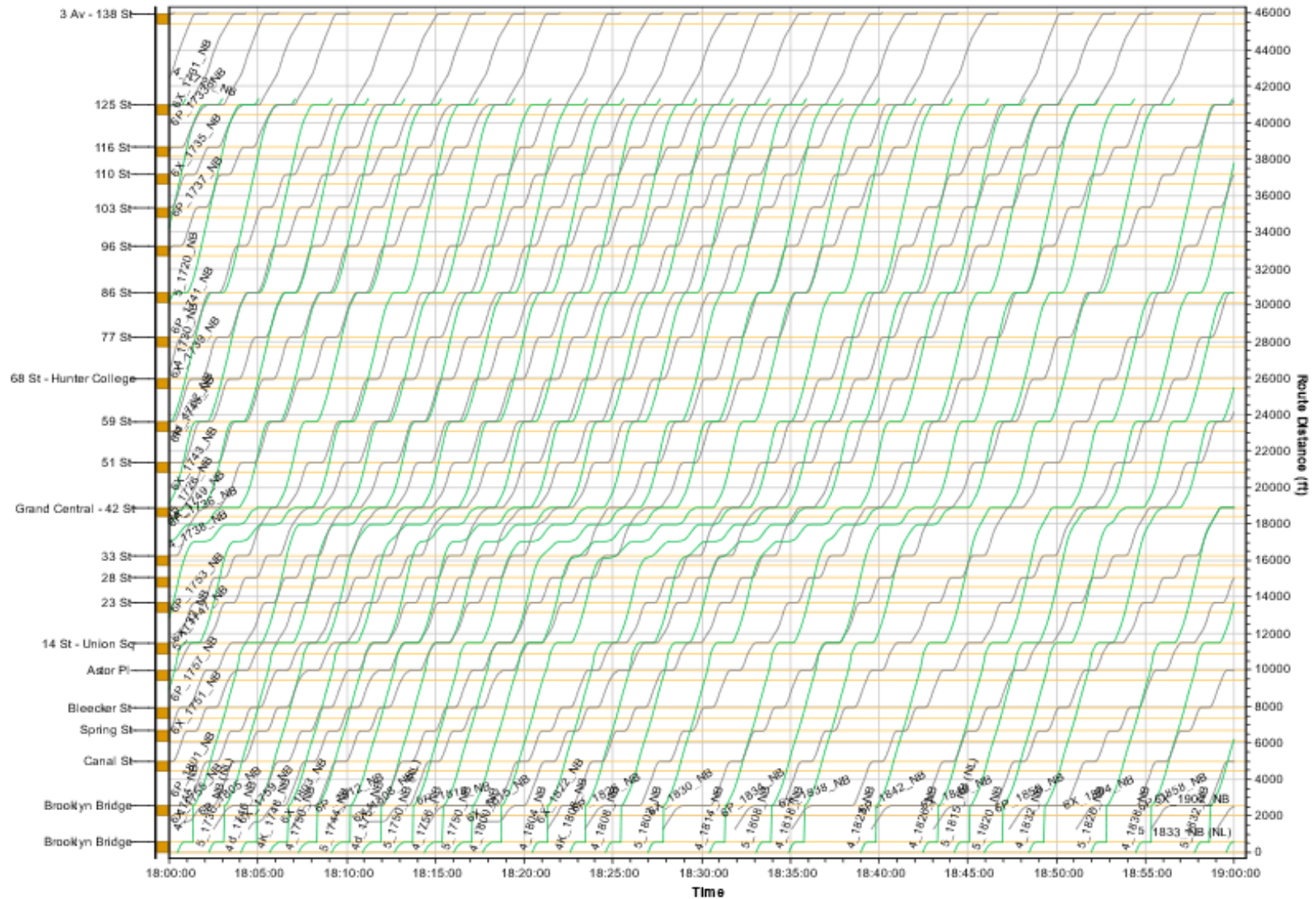
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-7: Future Baseline (CBTC) String Chart - Brooklyn Bridge to 138 Street - Northbound - 5:00 to 6:00 p.m.



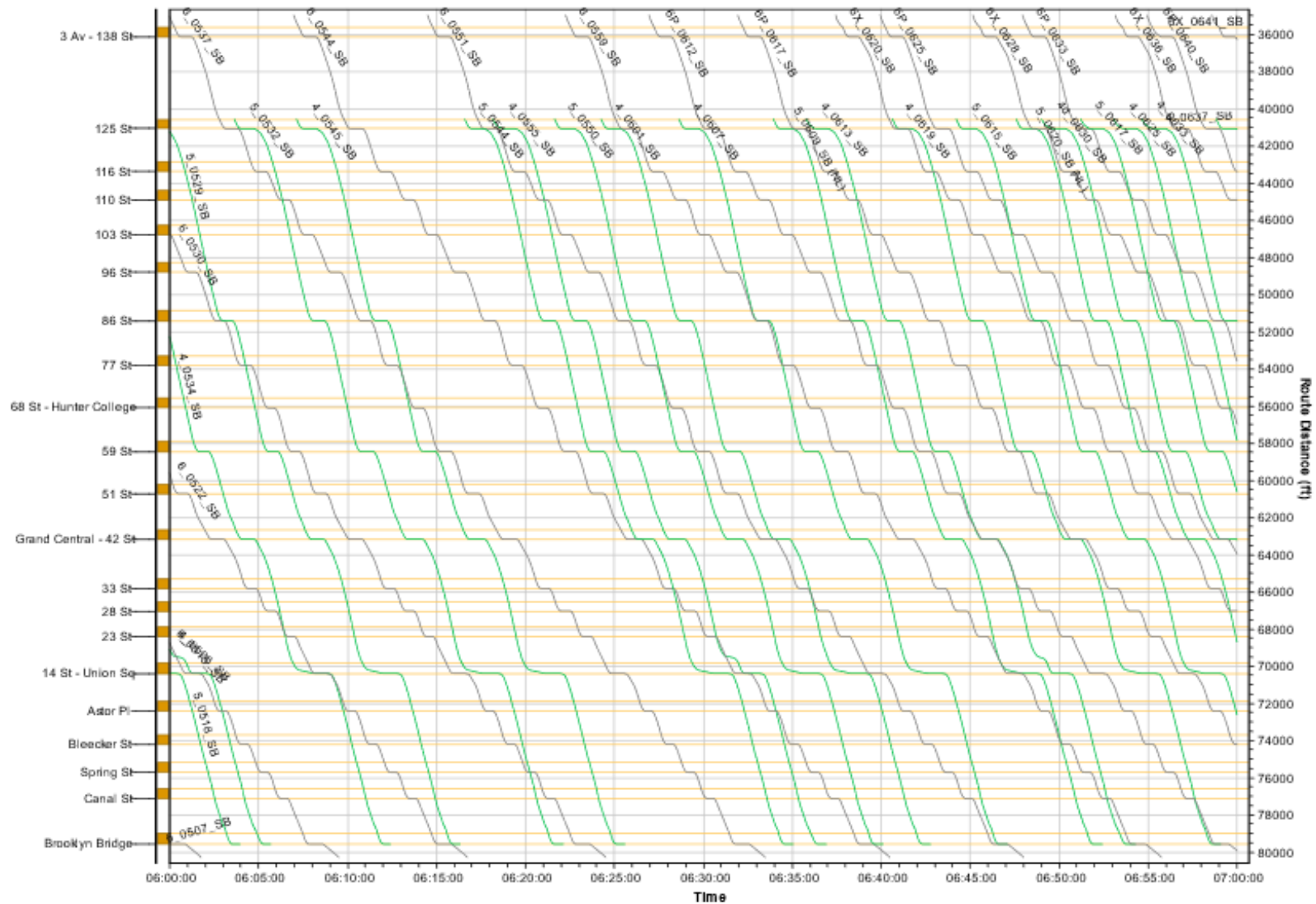
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-8: Future Baseline (CBTC) String Chart - Brooklyn Bridge to 138 Street - Northbound - 6:00 to 7:00 p.m.



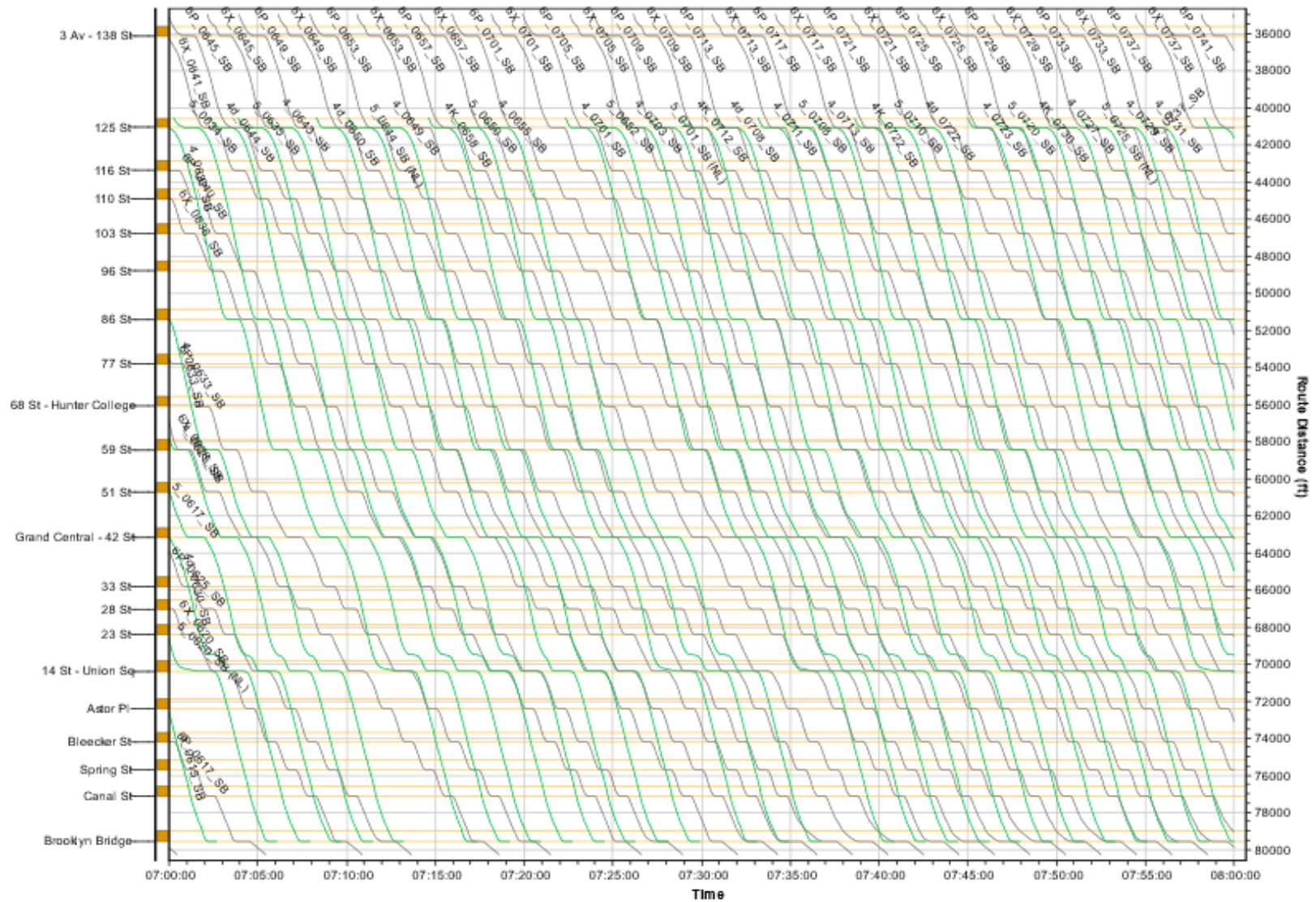
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-9: Future Baseline (CBTC) String Chart - 138 Street to Brooklyn Bridge - Southbound - 6:00 to 7:00 a.m.



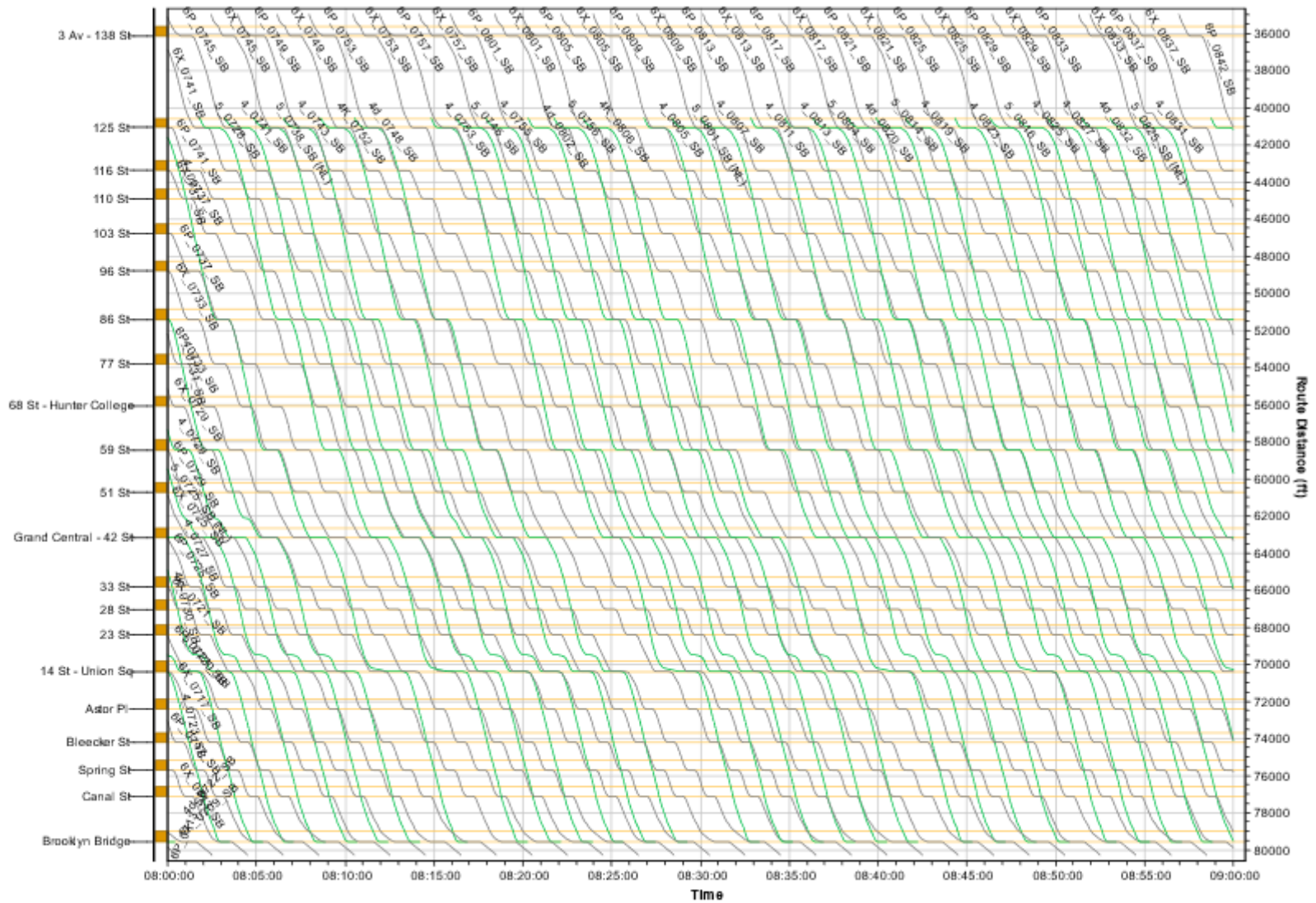
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-10: Future Baseline (CBTC) String Chart - 138 Street to Brooklyn Bridge - Southbound - 7:00 to 8:00 a.m.



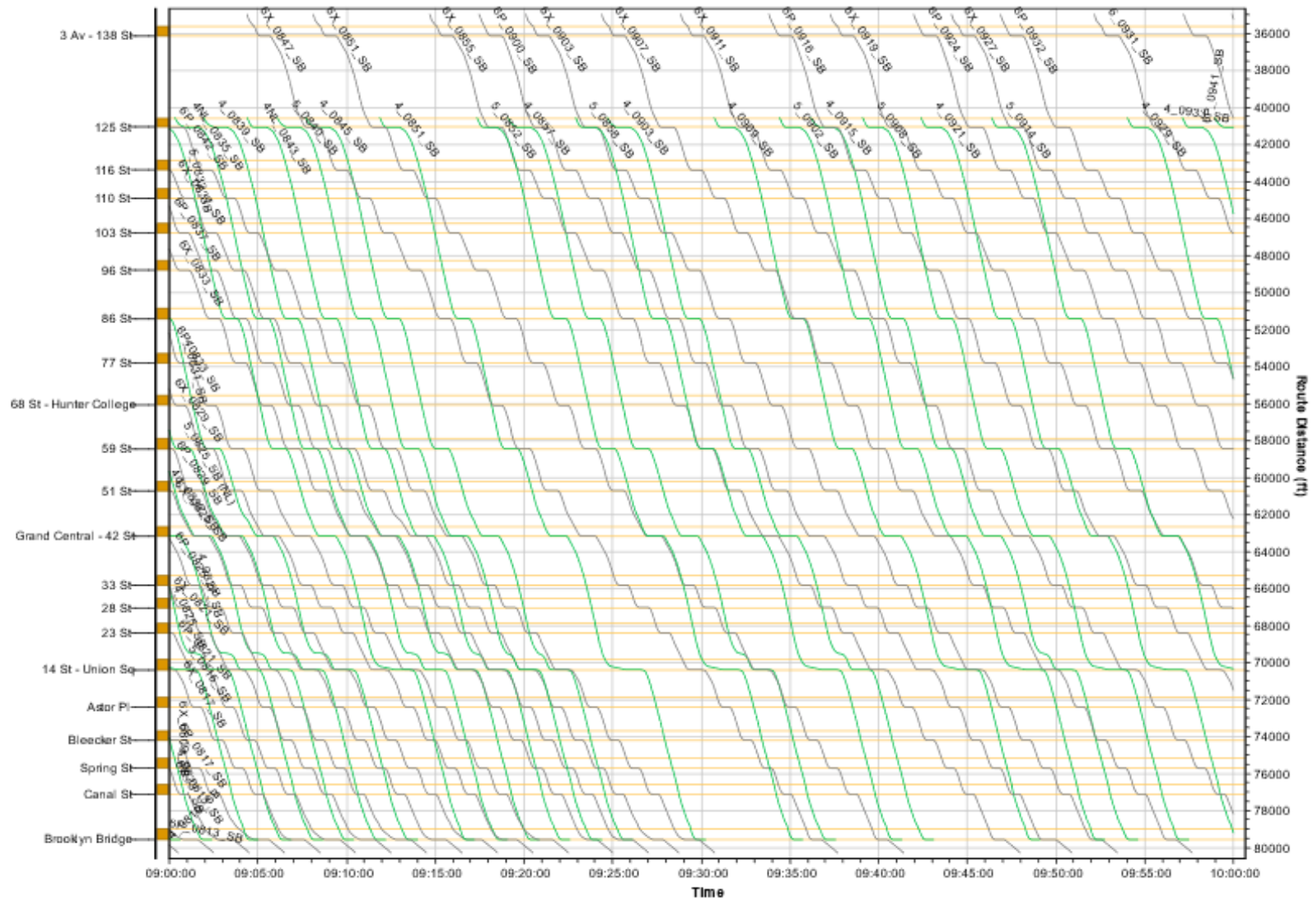
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-11: Future Baseline (CBTC) String Chart - 138 Street to Brooklyn Bridge - Southbound - 8:00 to 9:00 a.m.



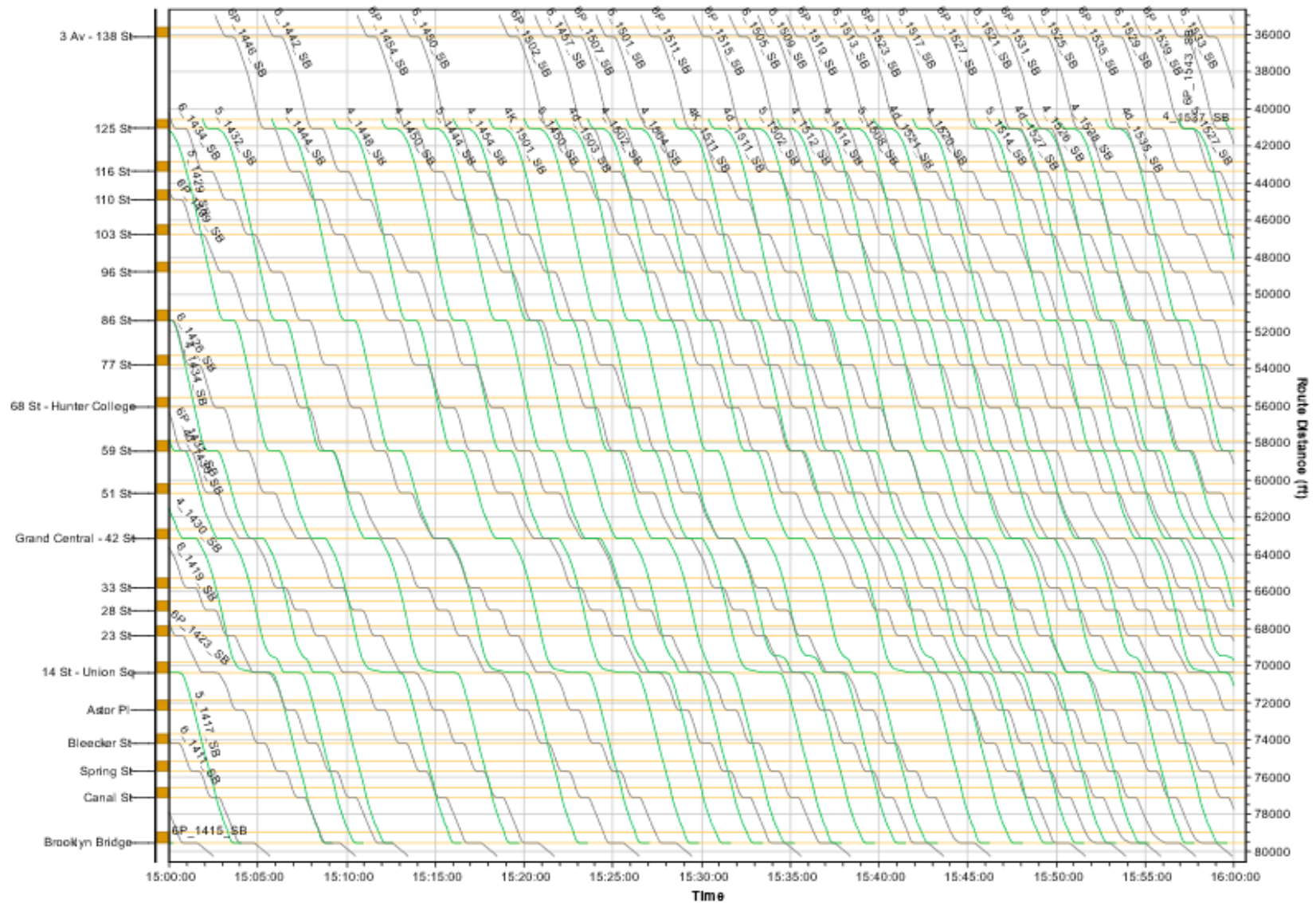
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-12: Future Baseline (CBTC) String Chart - 138 Street to Brooklyn Bridge - Southbound - 9:00 to 10:00 a.m.



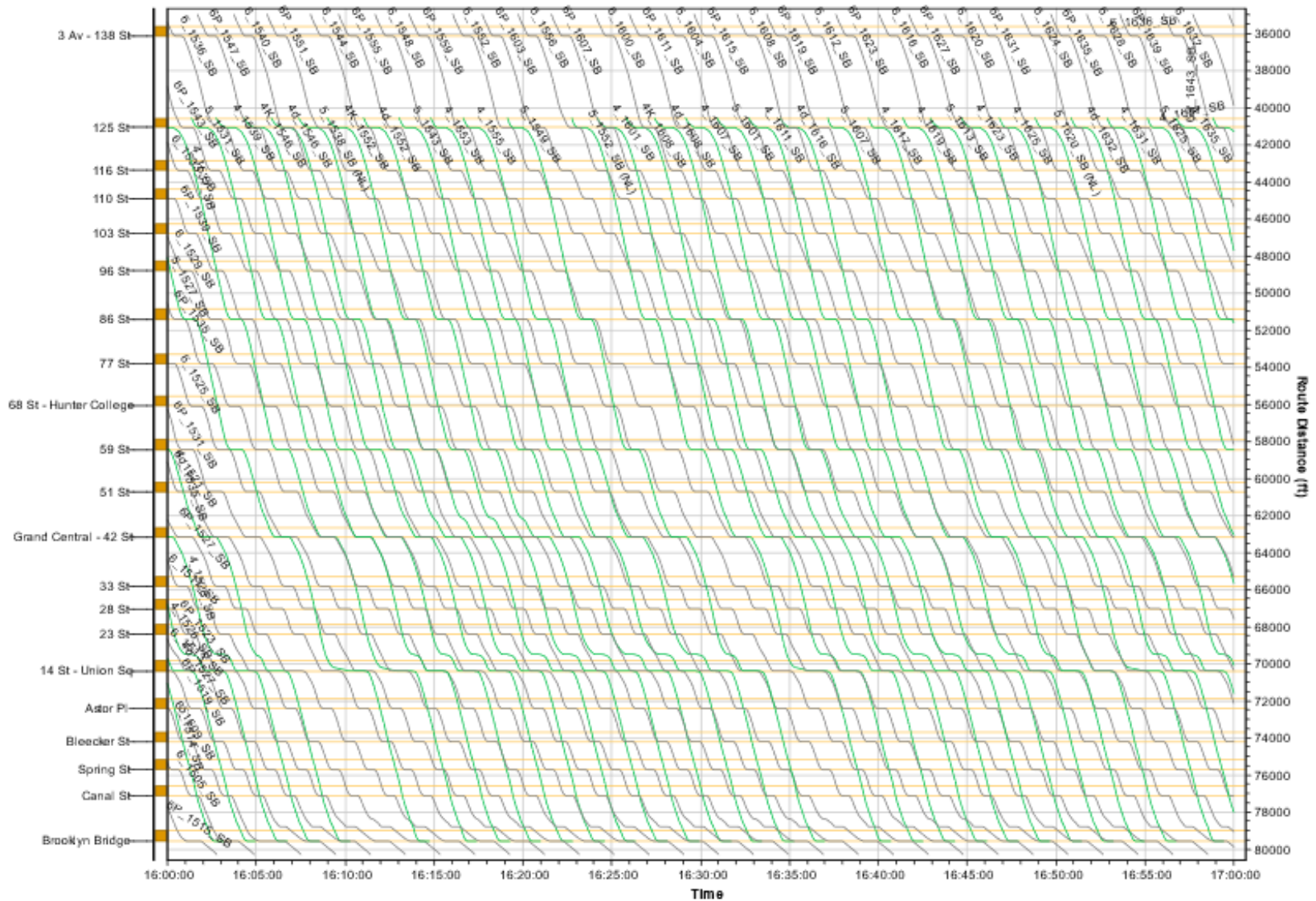
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-13: Future Baseline (CBTC) String Chart - 138 Street to Brooklyn Bridge - Southbound - 3:00 to 4:00 p.m.



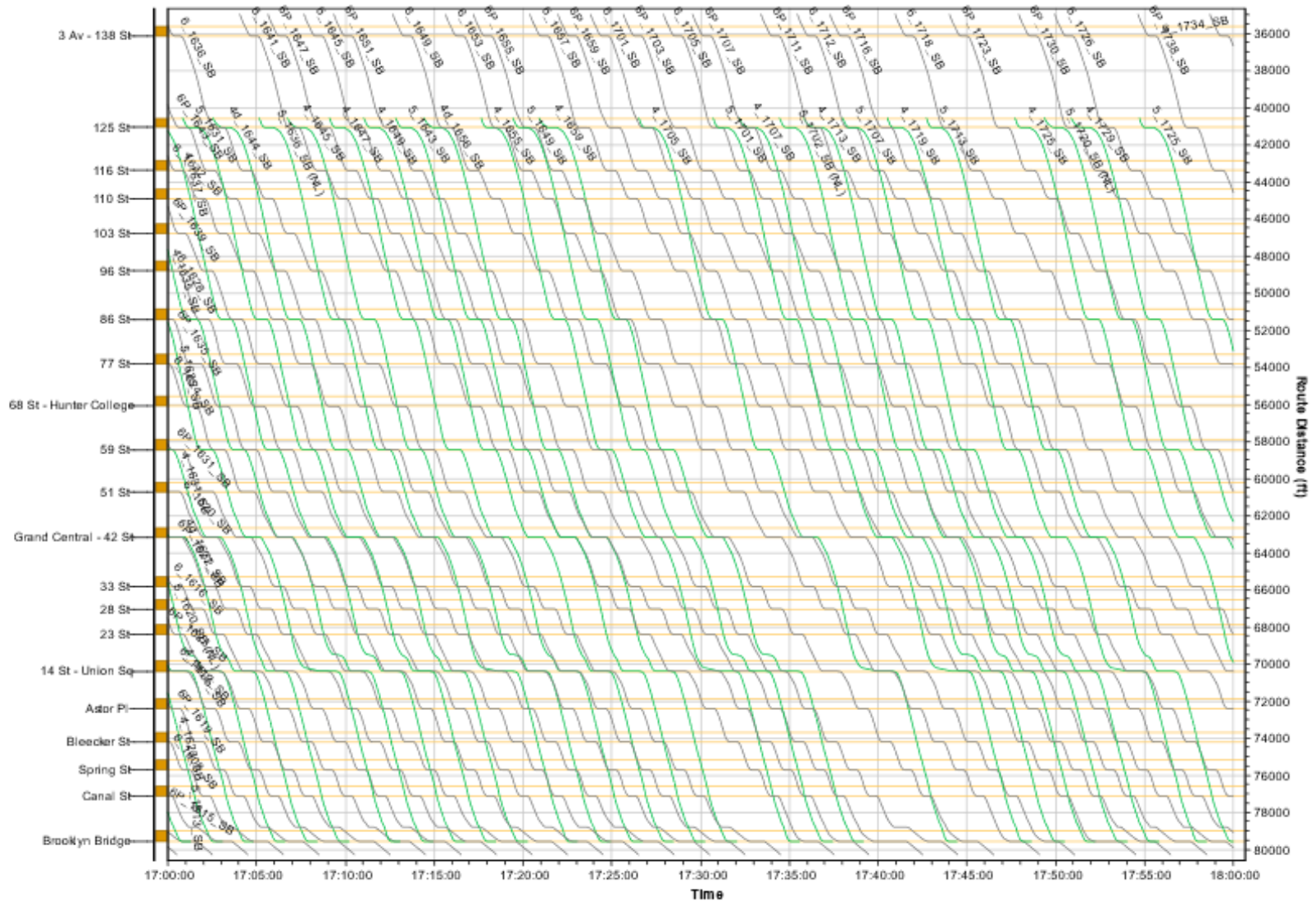
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-14: Future Baseline (CBTC) String Chart - 138 Street to Brooklyn Bridge - Southbound - 4:00 to 5:00 p.m.



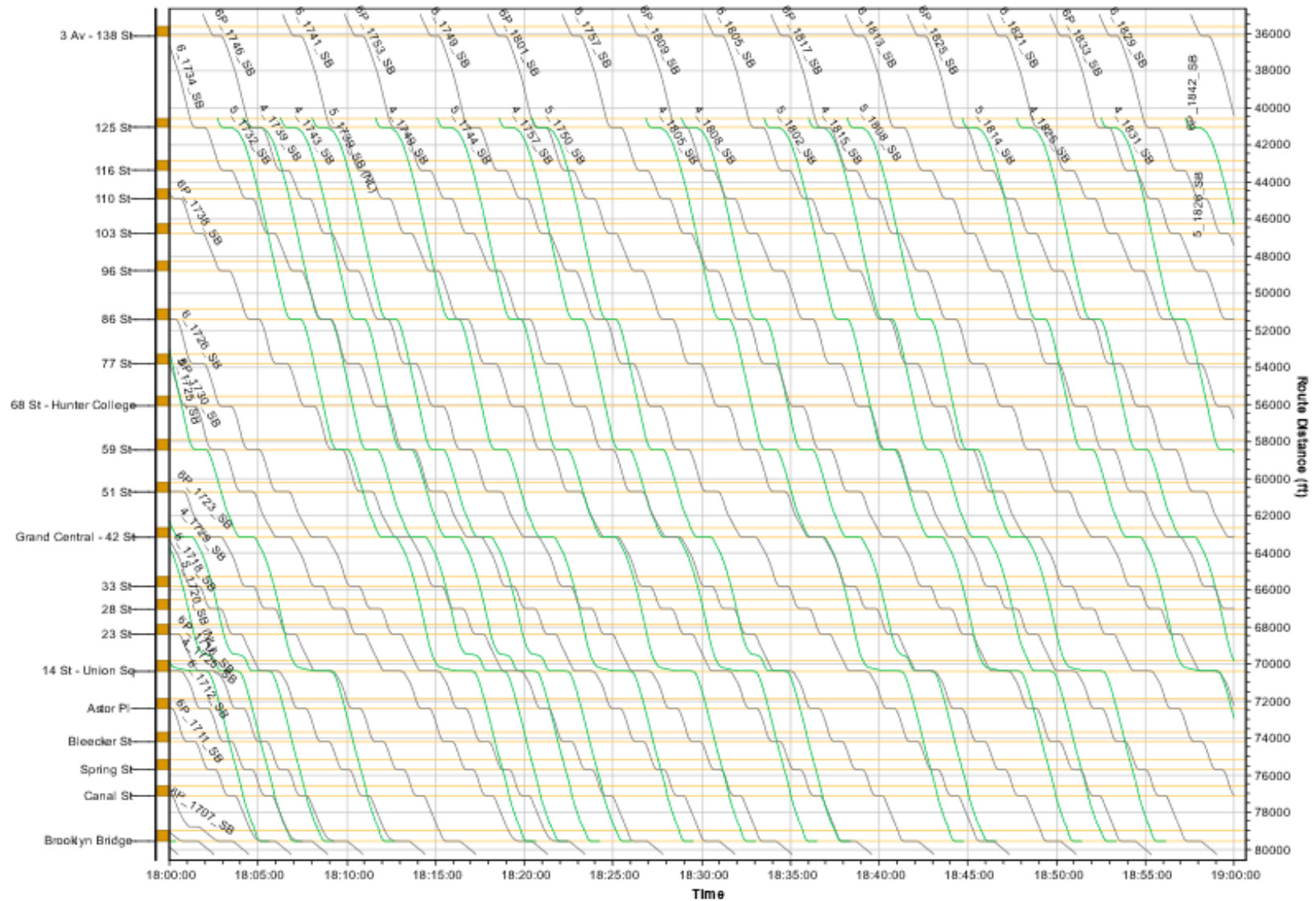
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-15: Future Baseline (CBTC) String Chart - 138 Street to Brooklyn Bridge - Southbound - 5:00 to 6:00 p.m.



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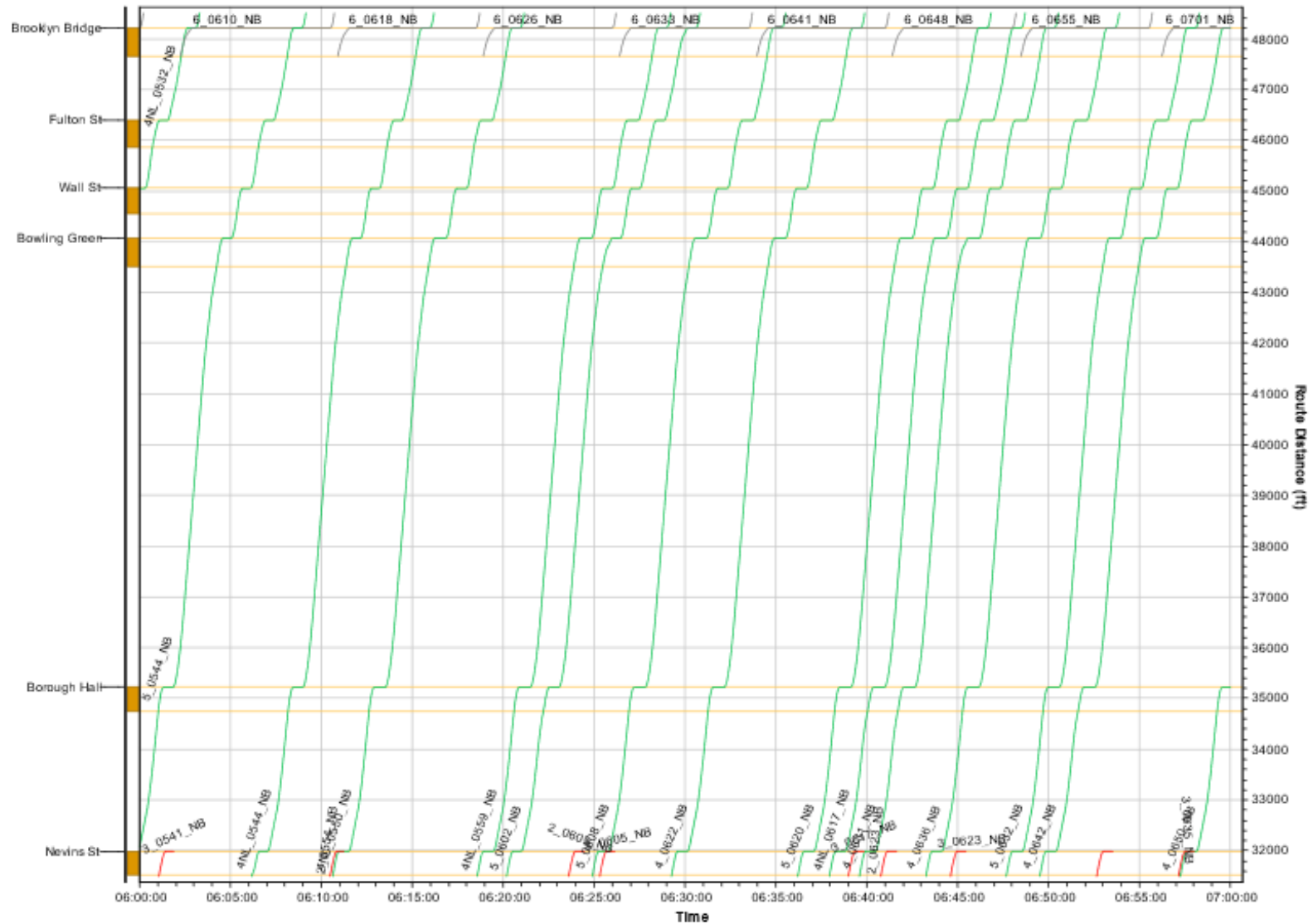
Figure G.4-16: Future Baseline (CBTC) String Chart - 138 Street to Brooklyn Bridge - Southbound - 6:00 to 7:00 p.m.



APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

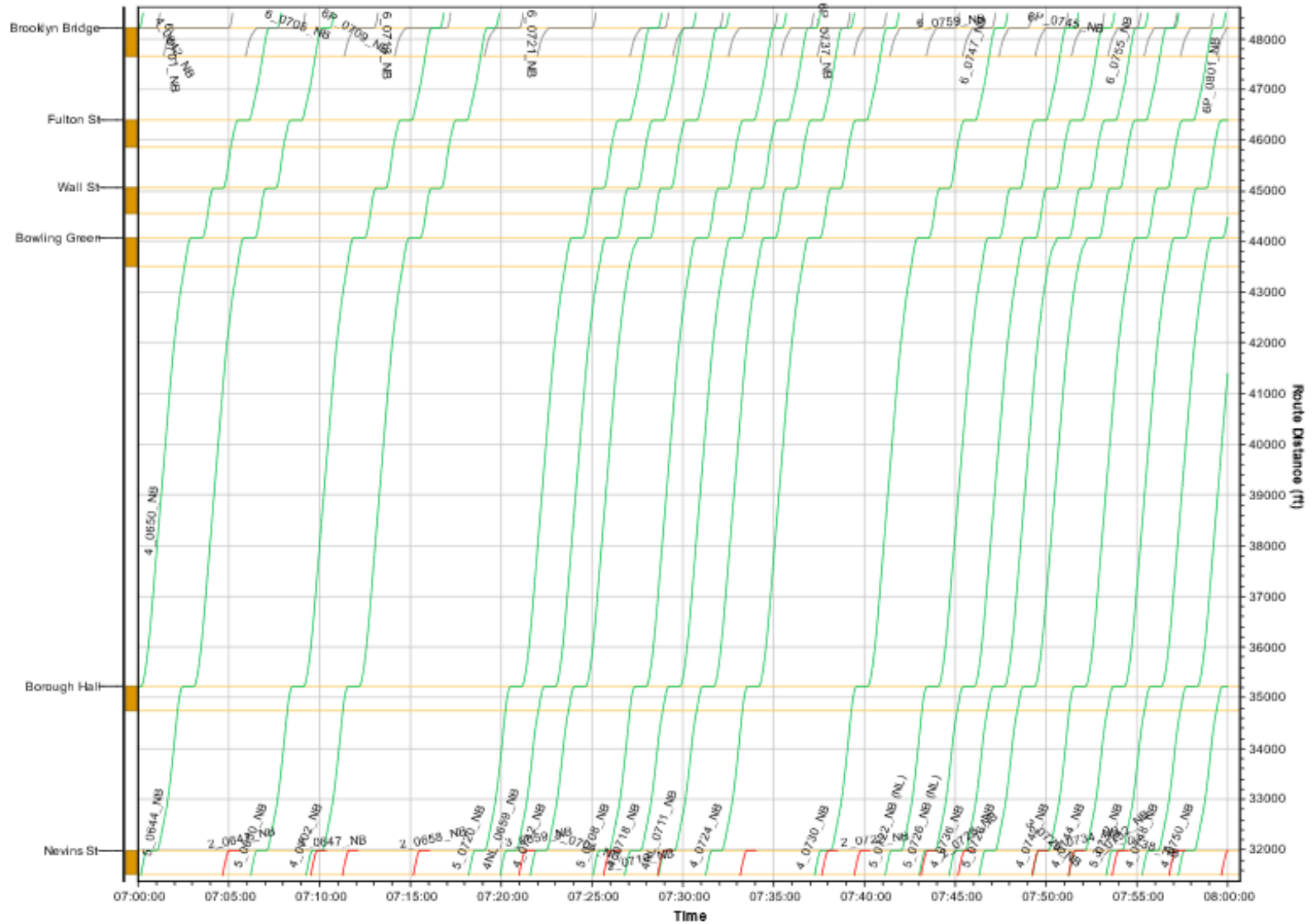
G.4.2 Brooklyn Bridge to Nevins Street

Figure G.4-17: Future Baseline (CBTC) String Chart - Nevins Street to Brooklyn Bridge - Northbound - 6:00 to 7:00 a.m.



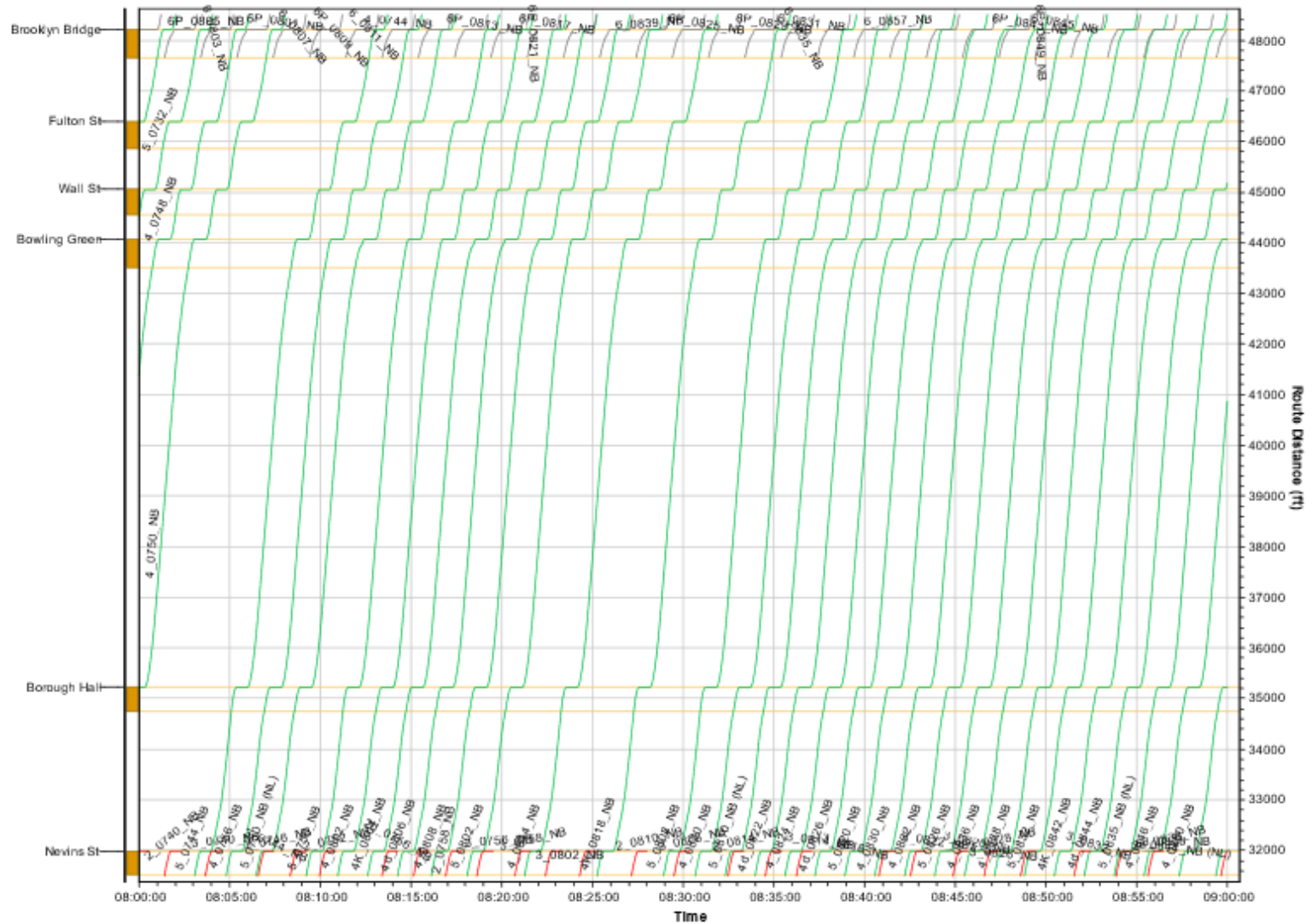
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-18: Future Baseline (CBTC) String Chart – Nevins Street to Brooklyn Bridge - Northbound - 7:00 to 8:00 a.m.



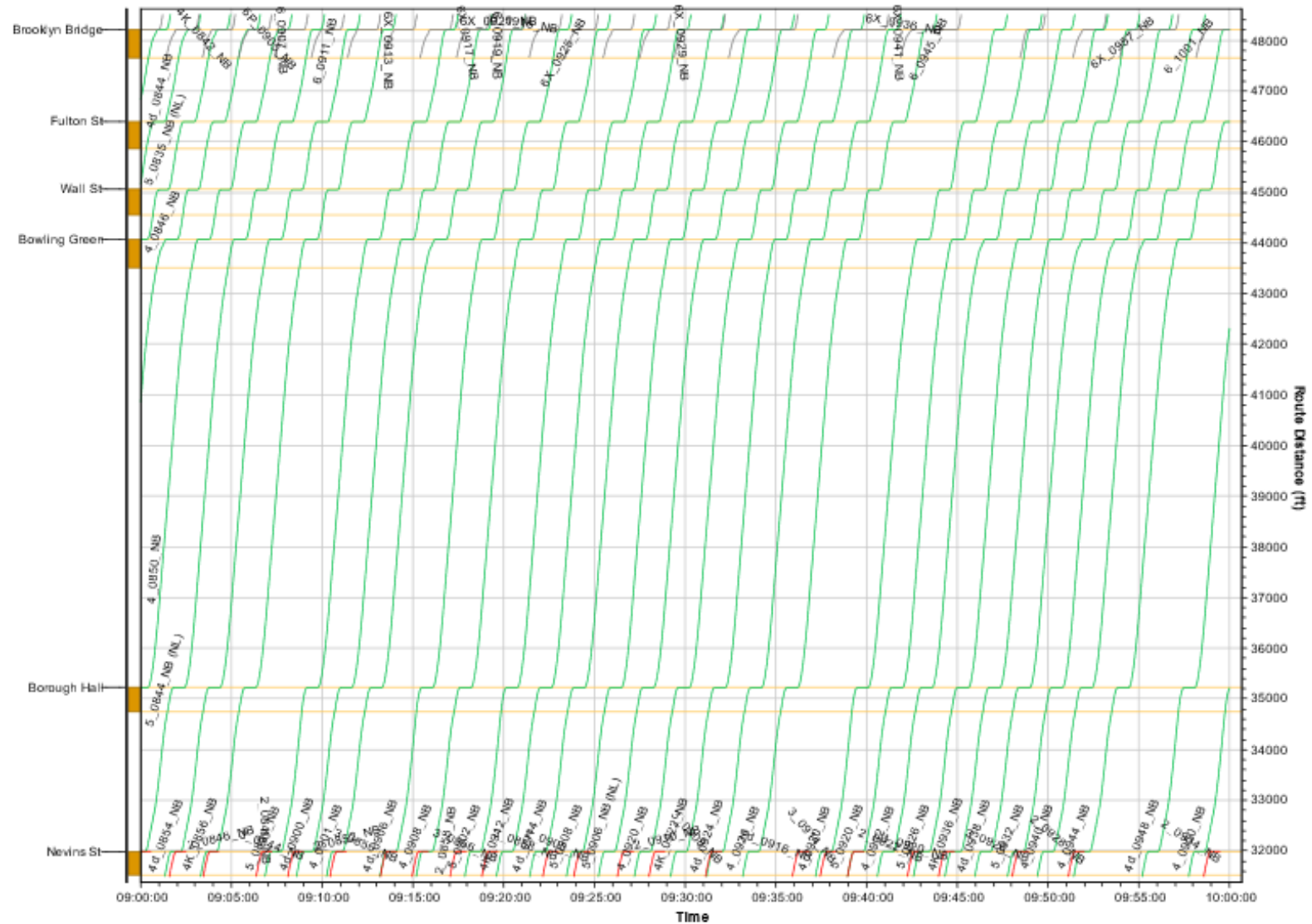
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Figure G.4-19: Future Baseline (CBTC) String Chart – Nevins Street to Brooklyn Bridge - Northbound - 8:00 to 9:00 a.m.



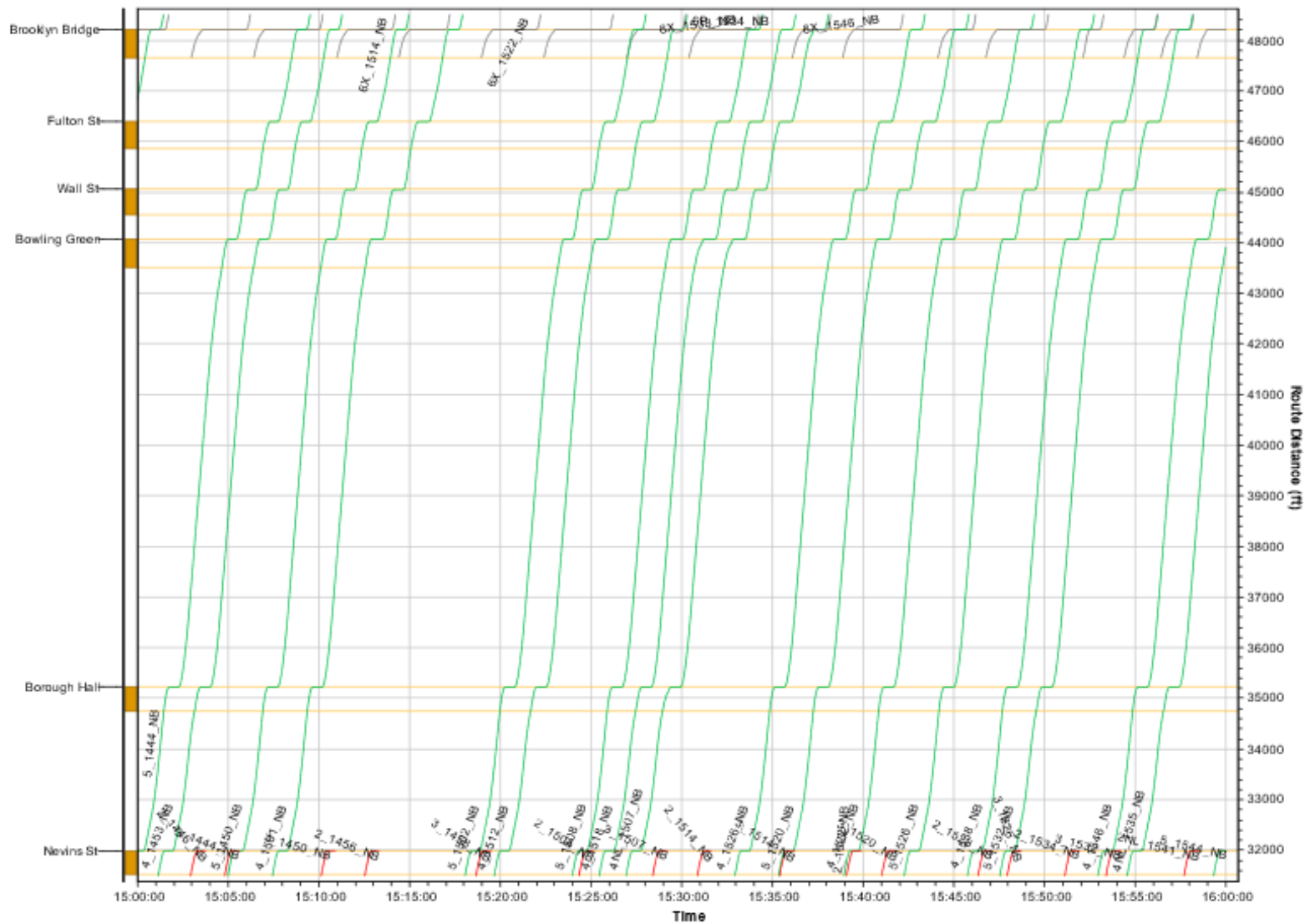
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-20: Future Baseline (CBTC) String Chart - Nevins Street to Brooklyn Bridge - Northbound - 9:00 to 10:00 a.m.



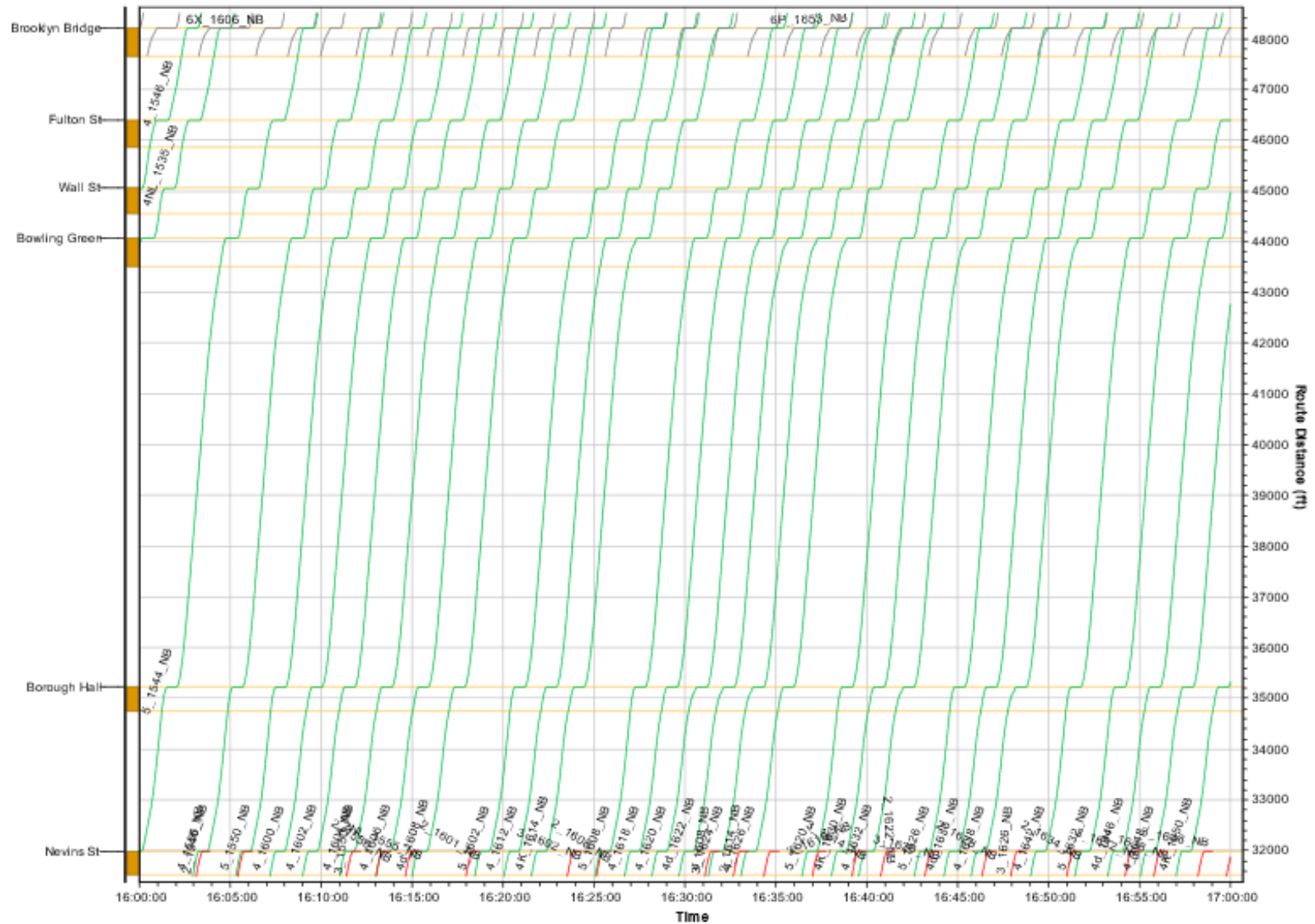
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-21: Future Baseline (CBTC) String Chart - Nevins Street to Brooklyn Bridge - Northbound - 3:00 to 4:00 p.m.



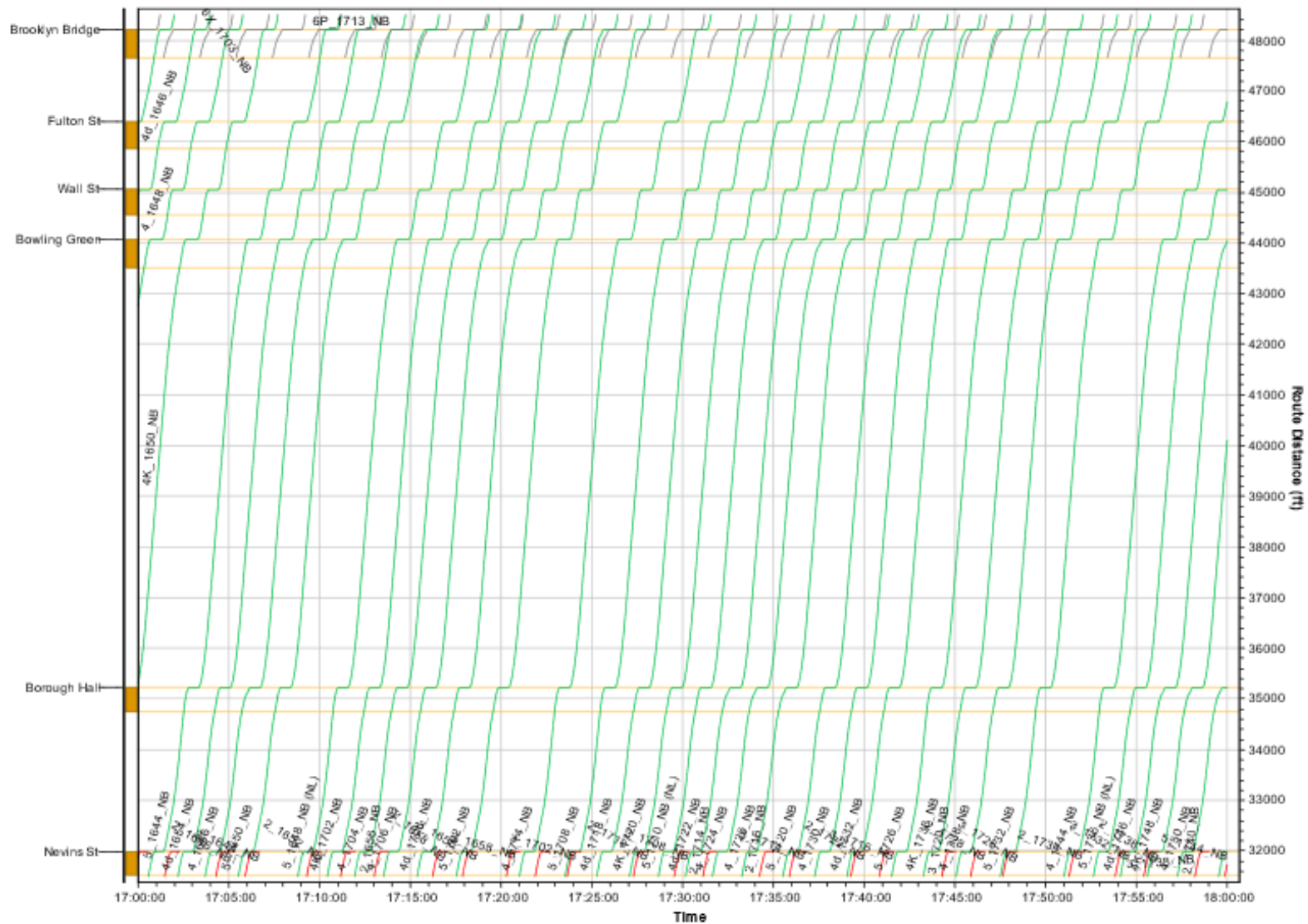
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-22: Future Baseline (CBTC) String Chart - Nevins Street to Brooklyn Bridge - Northbound - 4:00 to 5:00 p.m.



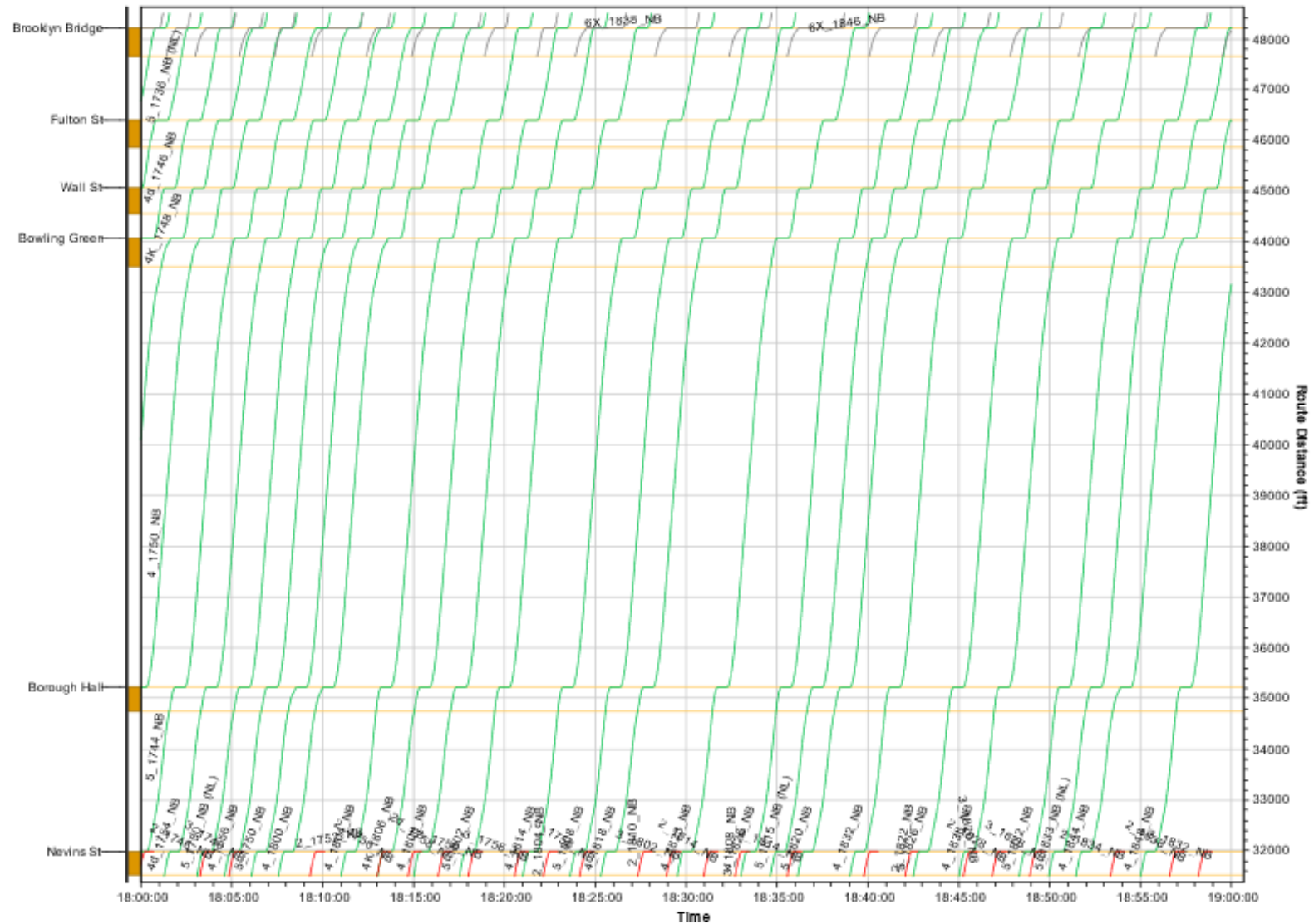
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-23: Future Baseline (CBTC) String Chart - Nevins Street to Brooklyn Bridge - Northbound - 5:00 to 6:00 p.m.



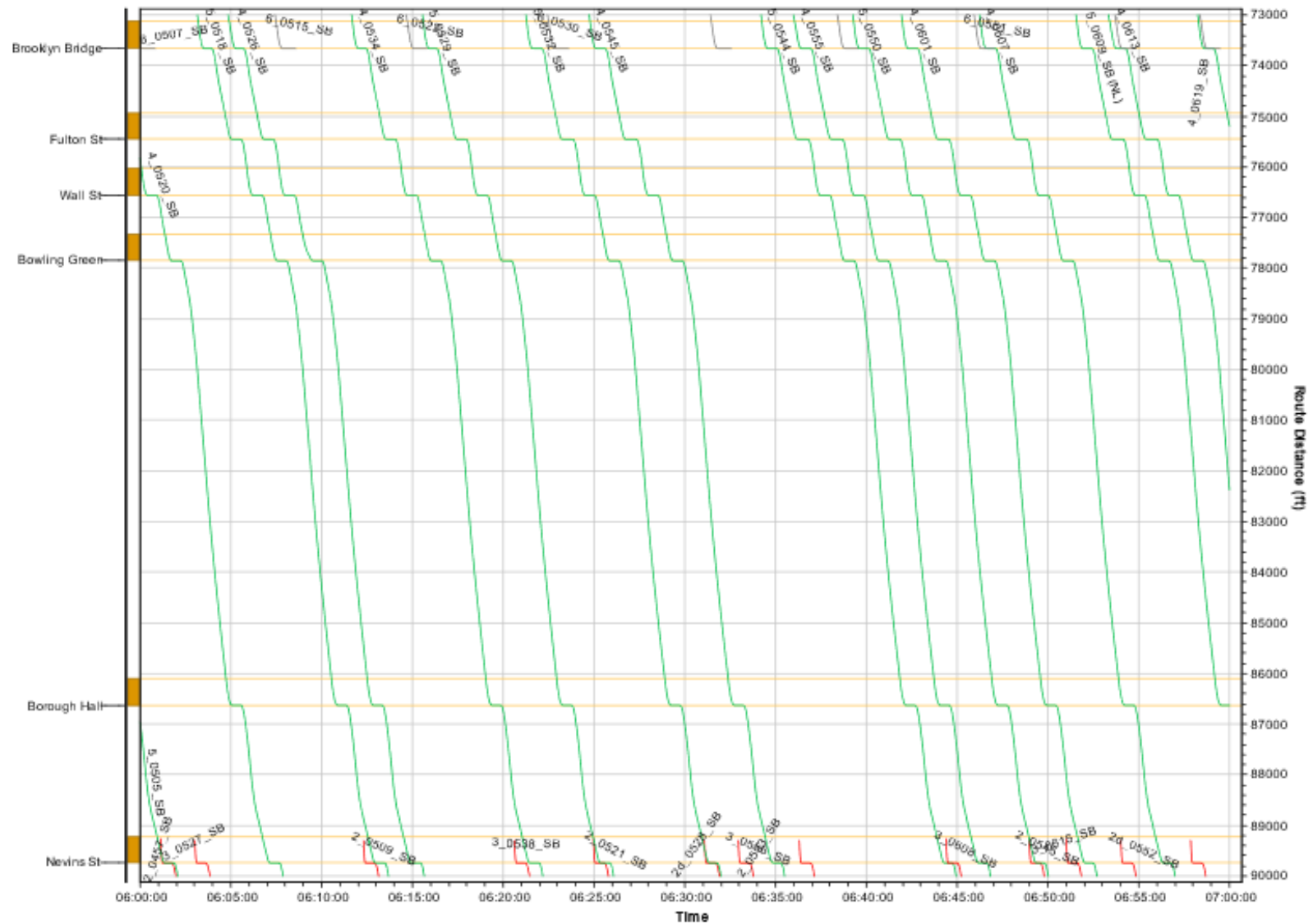
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-24: Future Baseline (CBTC) String Chart - Nevins Street to Brooklyn Bridge - Northbound - 6:00 to 7:00 p.m.



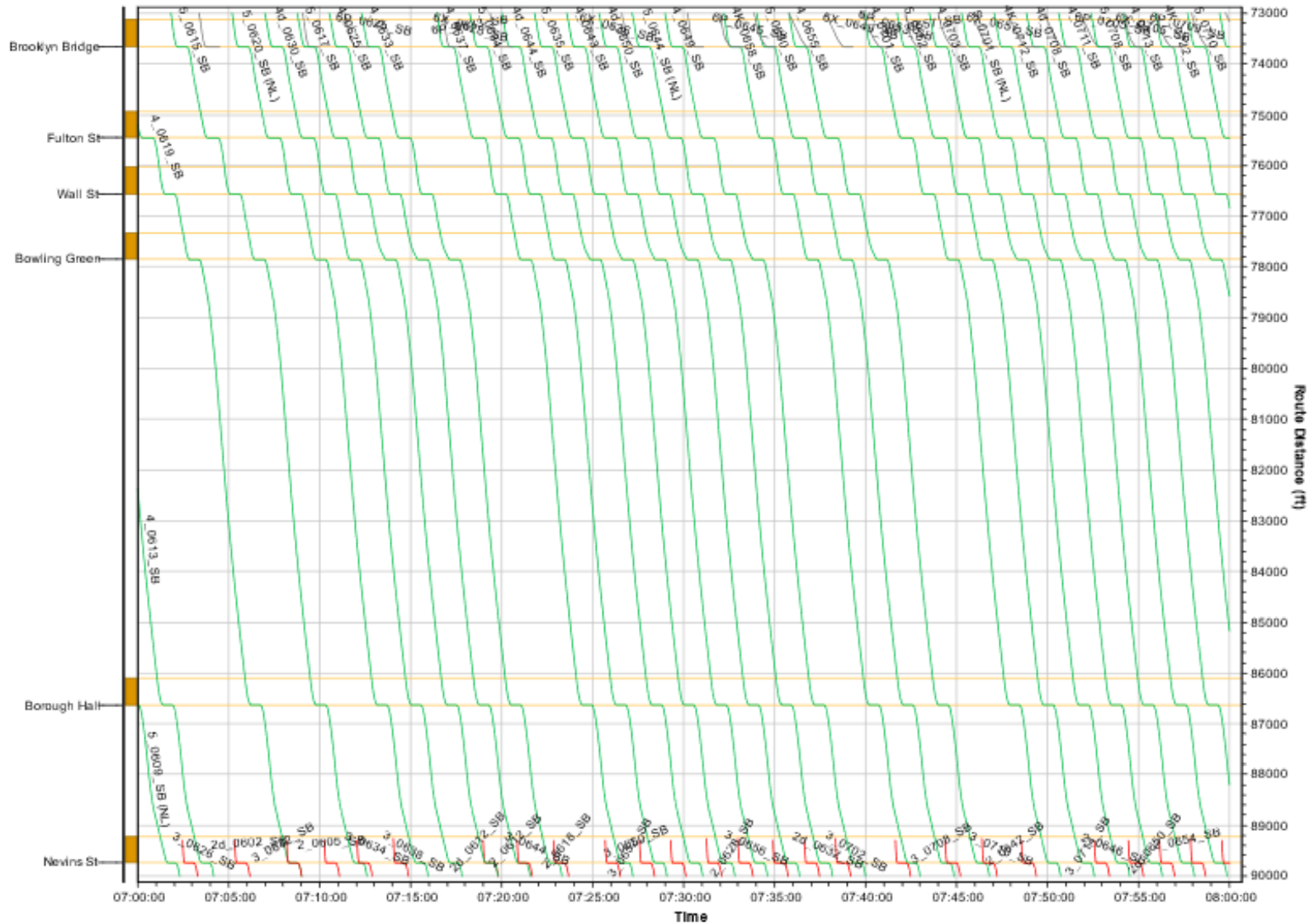
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-25: Future Baseline (CBTC) String Chart - Brooklyn Bridge to Nevins Street - Southbound - 6:00 to 7:00 a.m.



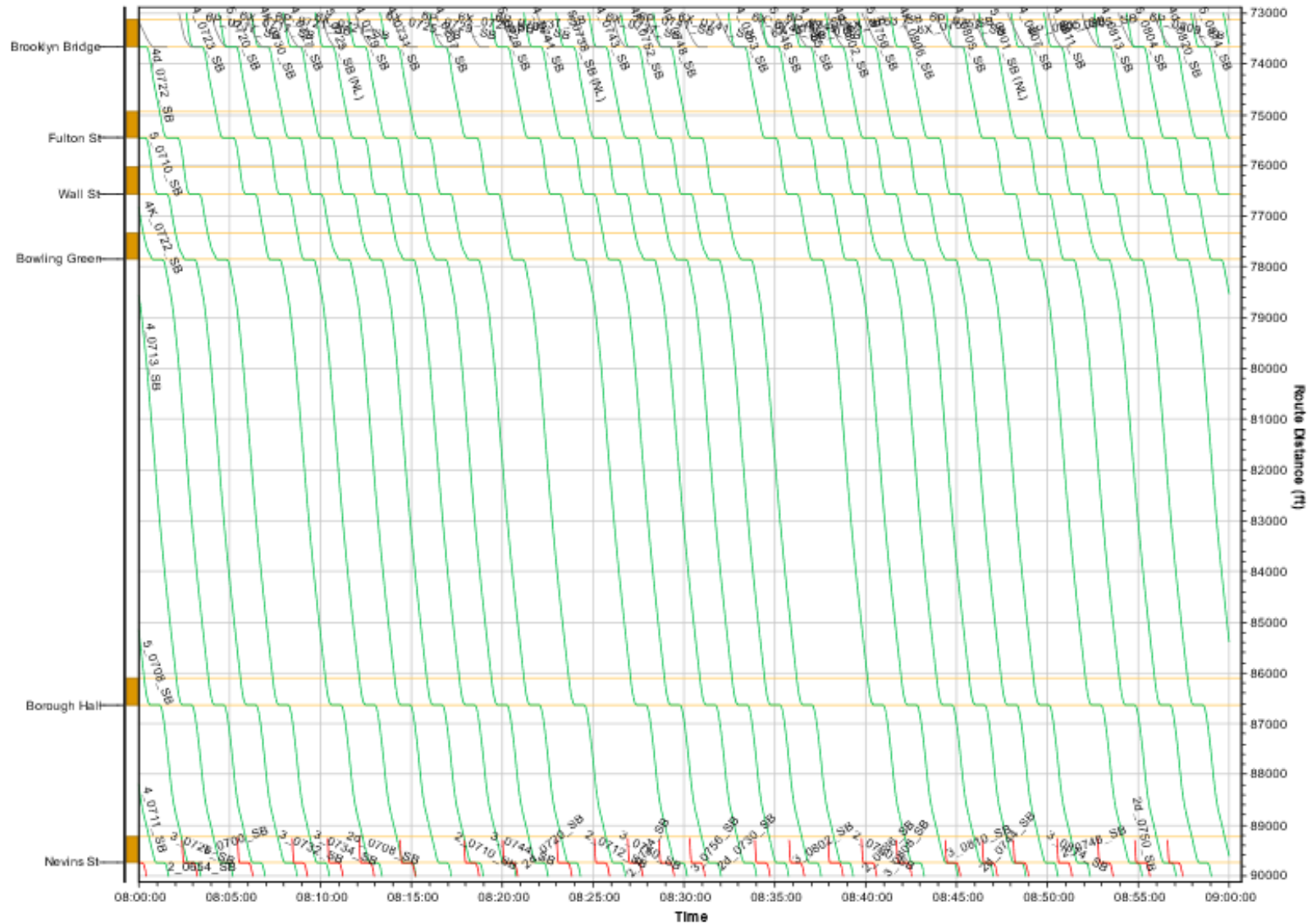
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-26: Future Baseline (CBTC) String Chart - Brooklyn Bridge to Nevins Street - Southbound - 7:00 to 8:00 a.m.



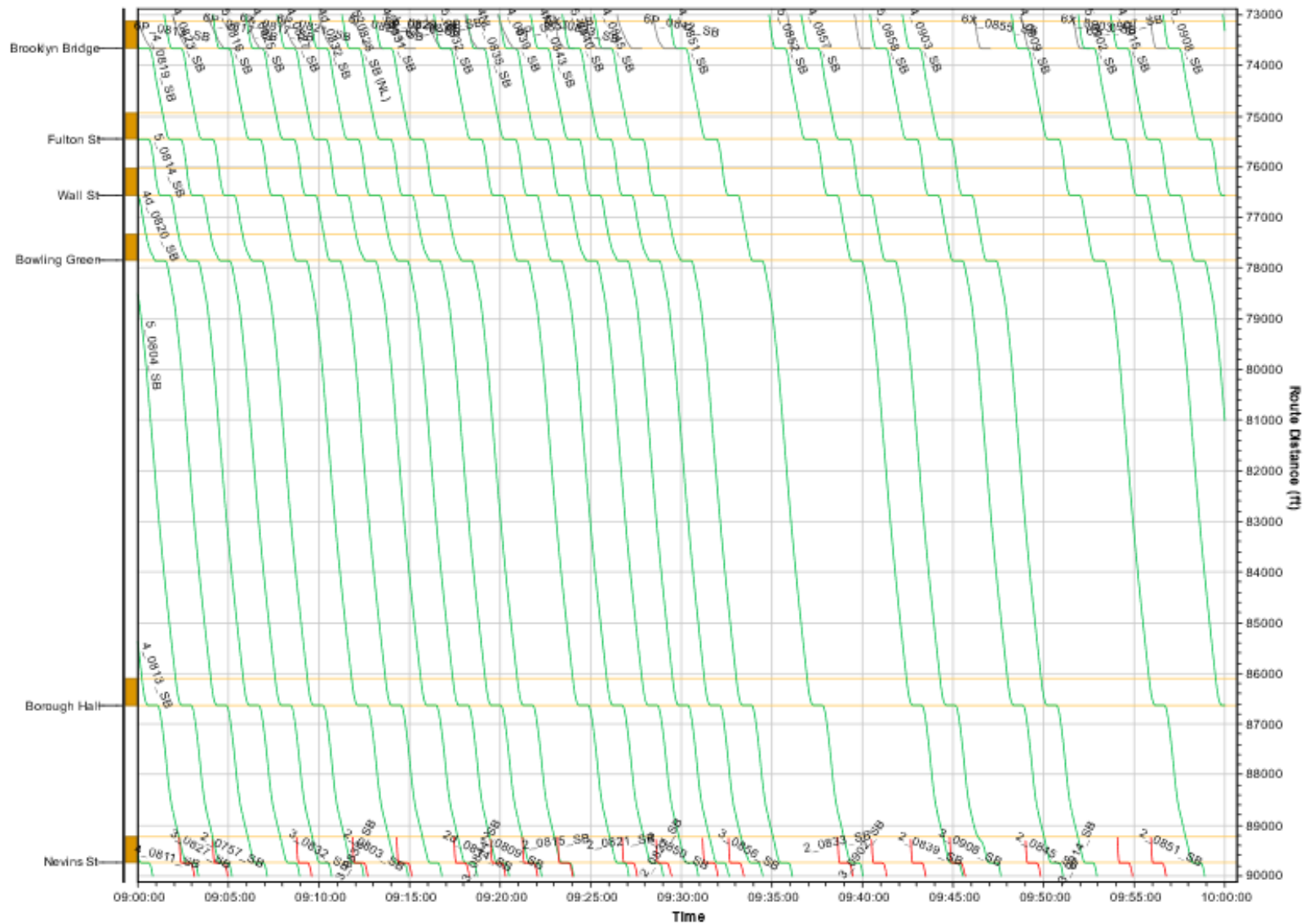
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-27: Future Baseline (CBTC) String Chart - Brooklyn Bridge to Nevins Street - Southbound - 8:00 to 9:00 a.m.



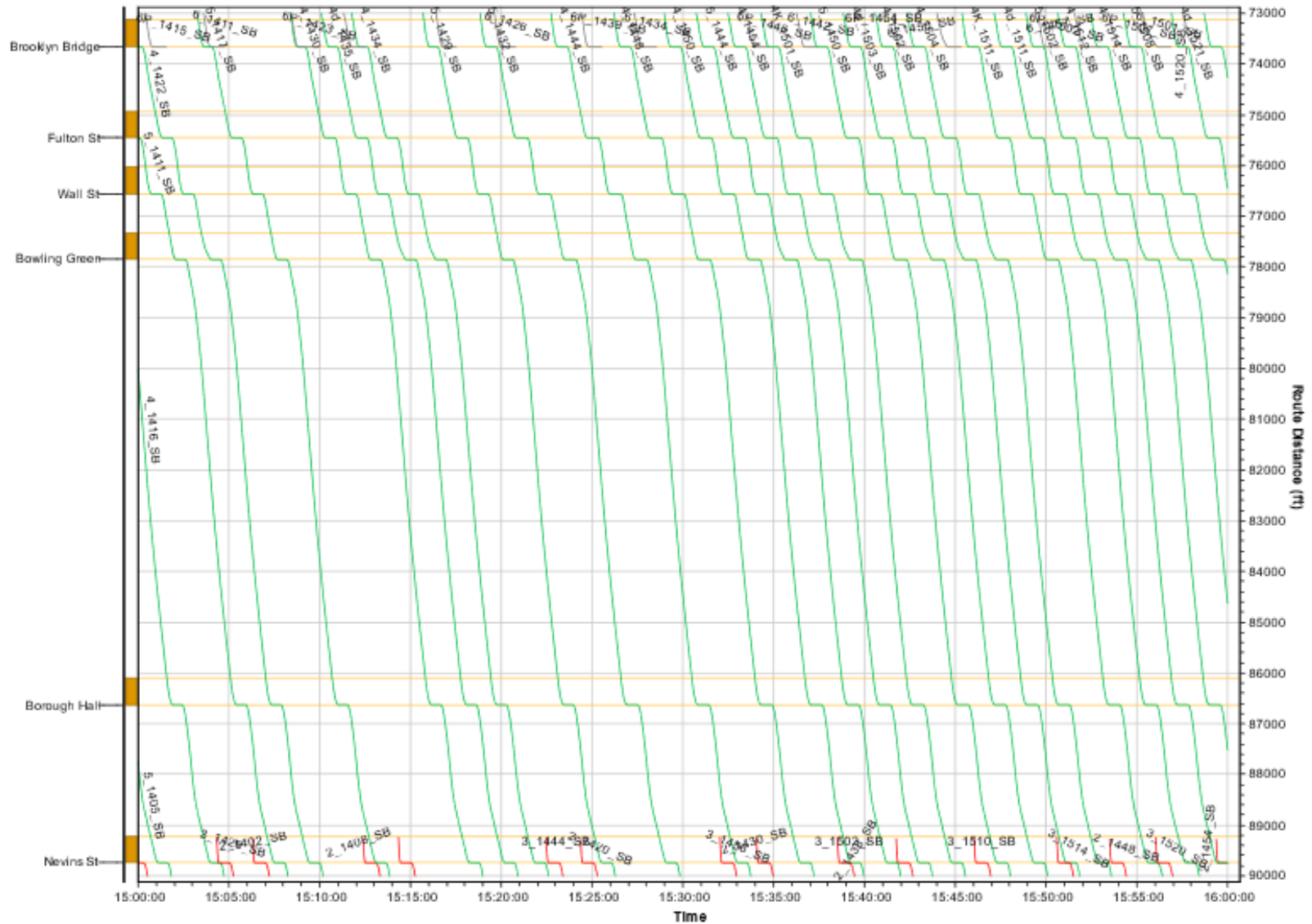
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-28: Future Baseline (CBTC) String Chart - Brooklyn Bridge to Nevins Street - Southbound - 9:00 to 10:00 a.m.



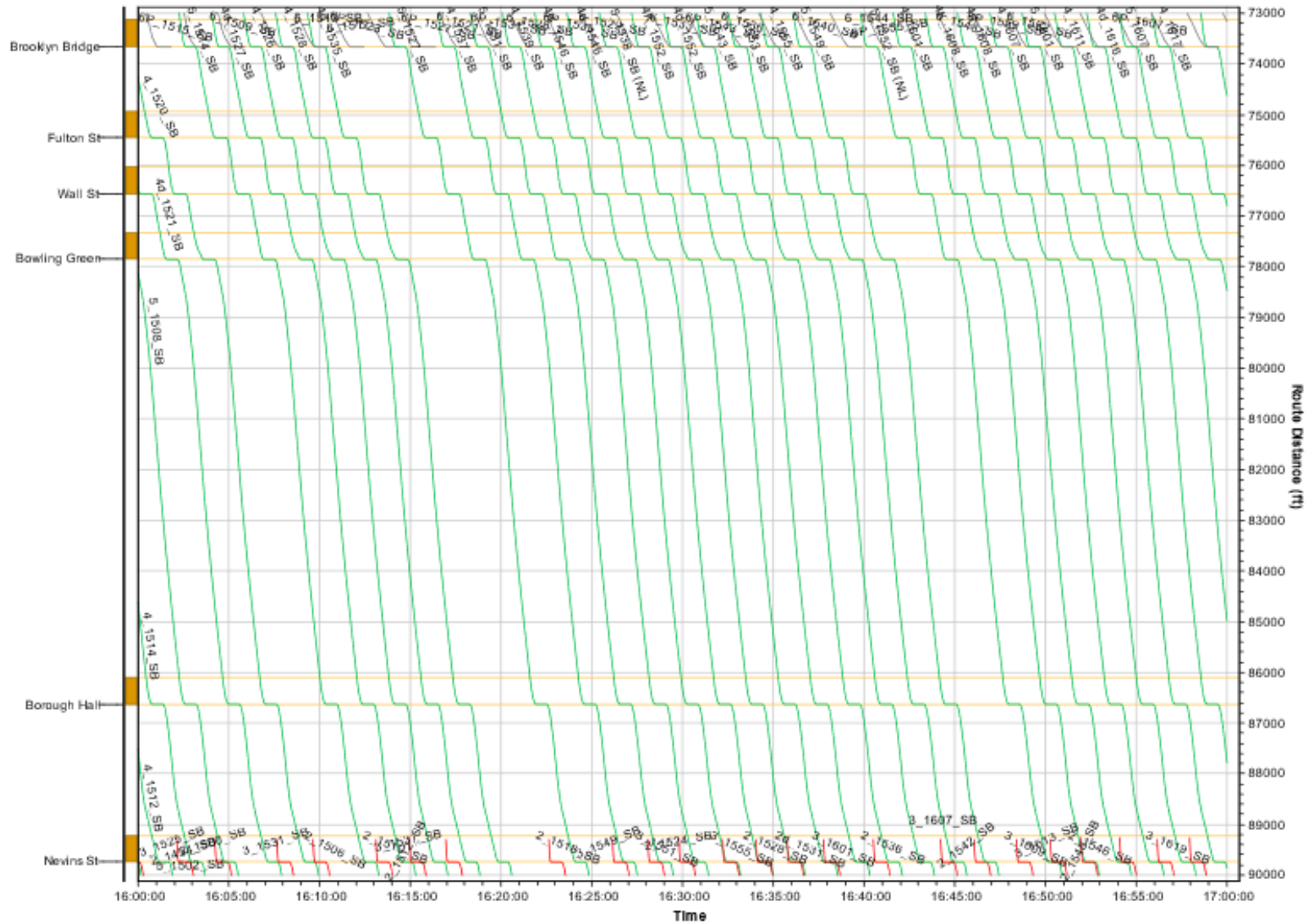
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-29: Future Baseline (CBTC) String Chart - Brooklyn Bridge to Nevins Street - Southbound - 3:00 to 4:00 p.m.



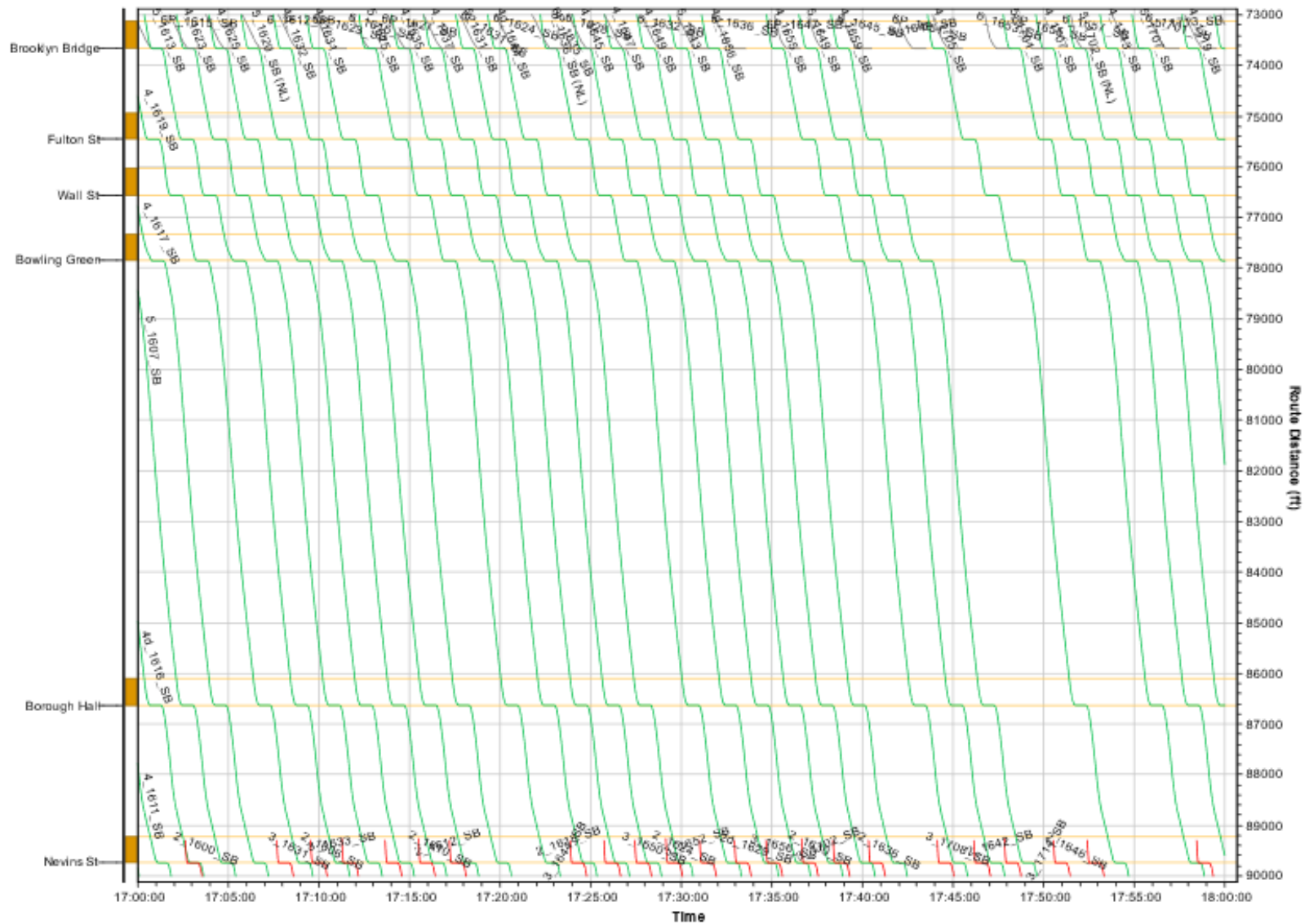
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-30: Future Baseline (CBTC) String Chart - Brooklyn Bridge to Nevins Street Southbound - 4:00 to 5:00 p.m.



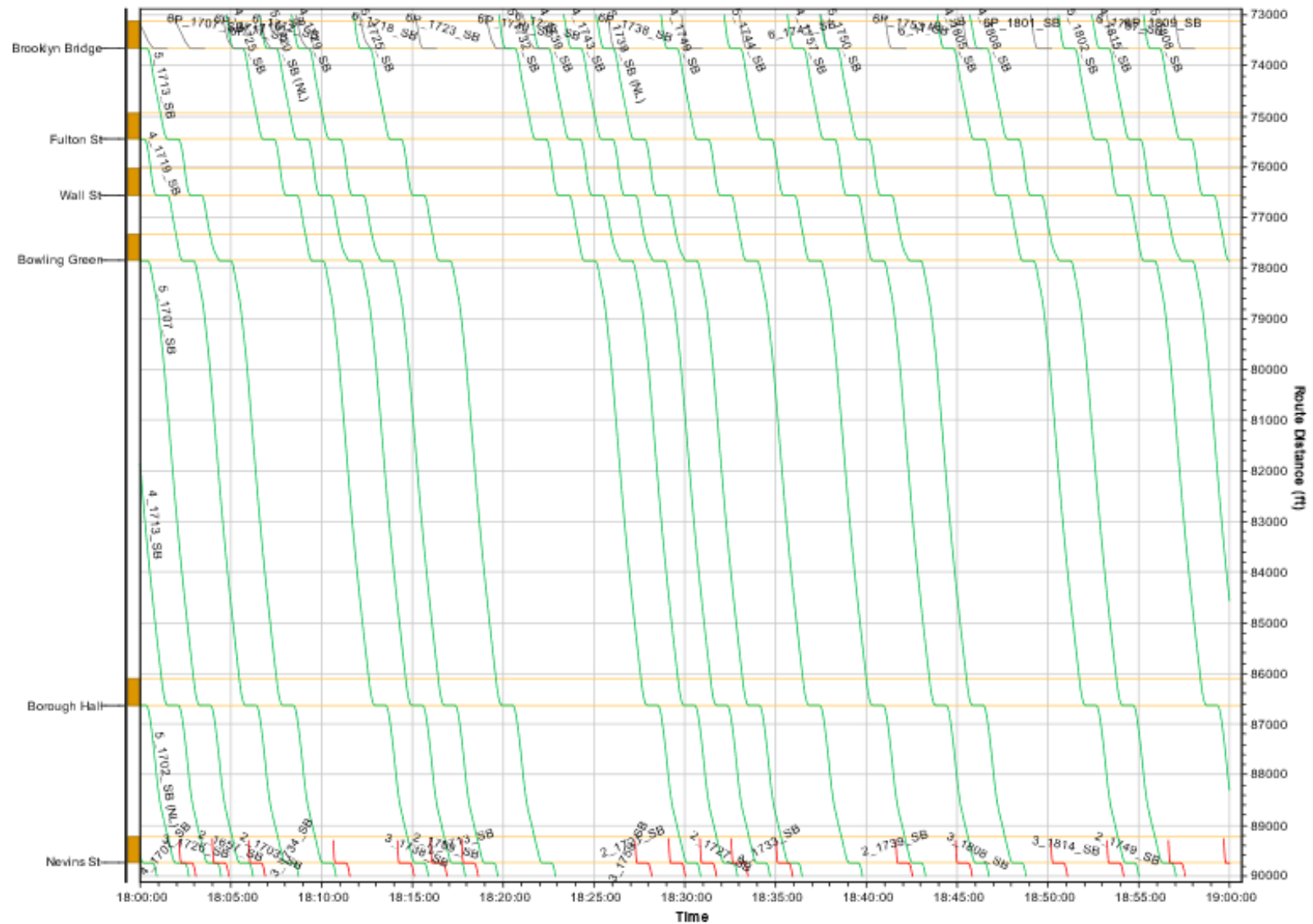
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-31: Future Baseline (CBTC) String Chart - Brooklyn Bridge to Nevins Street - Southbound - 5:00 to 6:00 p.m.



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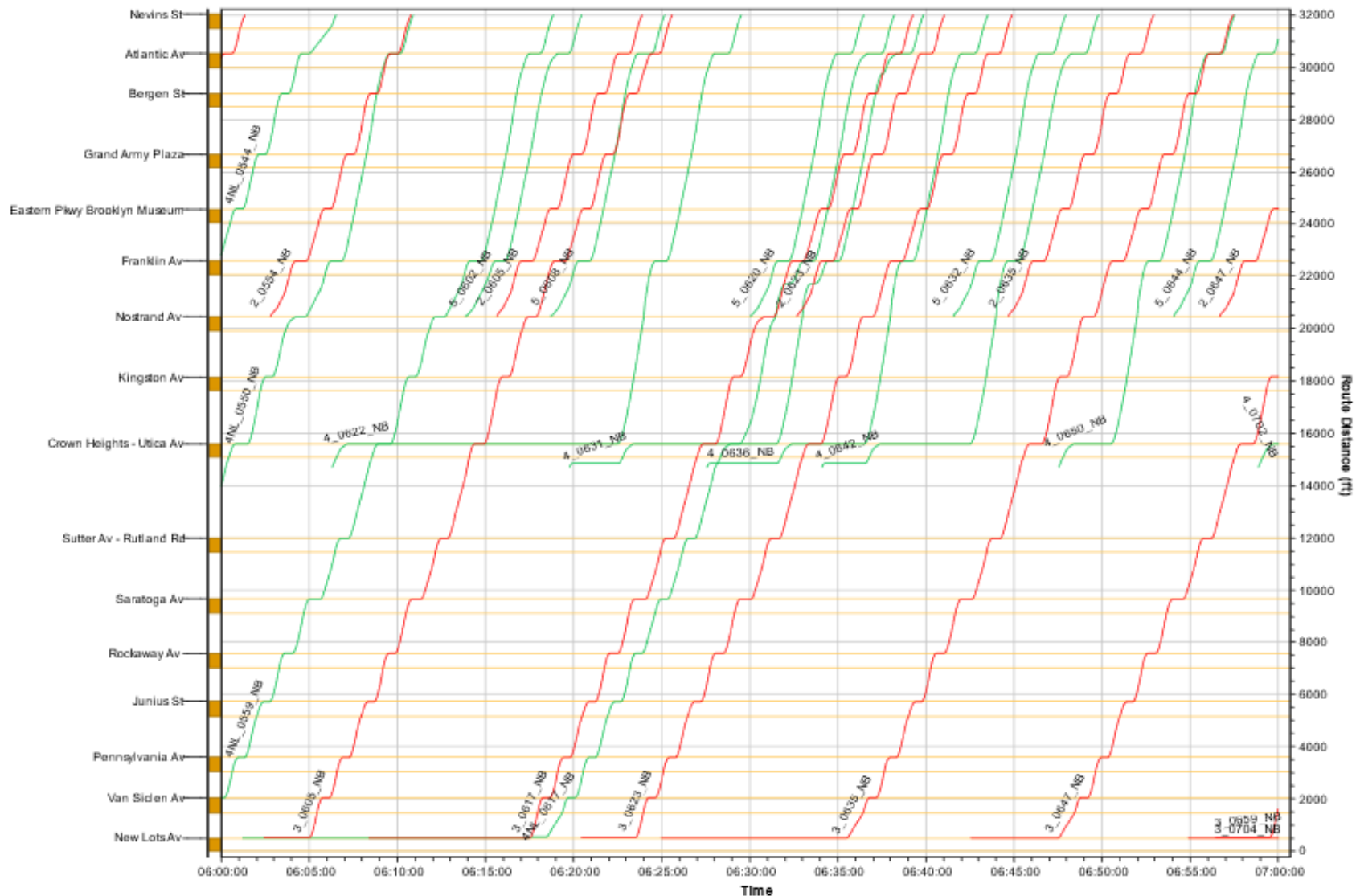
Figure G.4-32: Future Baseline (CBTC) String Chart - Brooklyn Bridge to Nevins Street - Southbound - 6:00 to 7:00 p.m.



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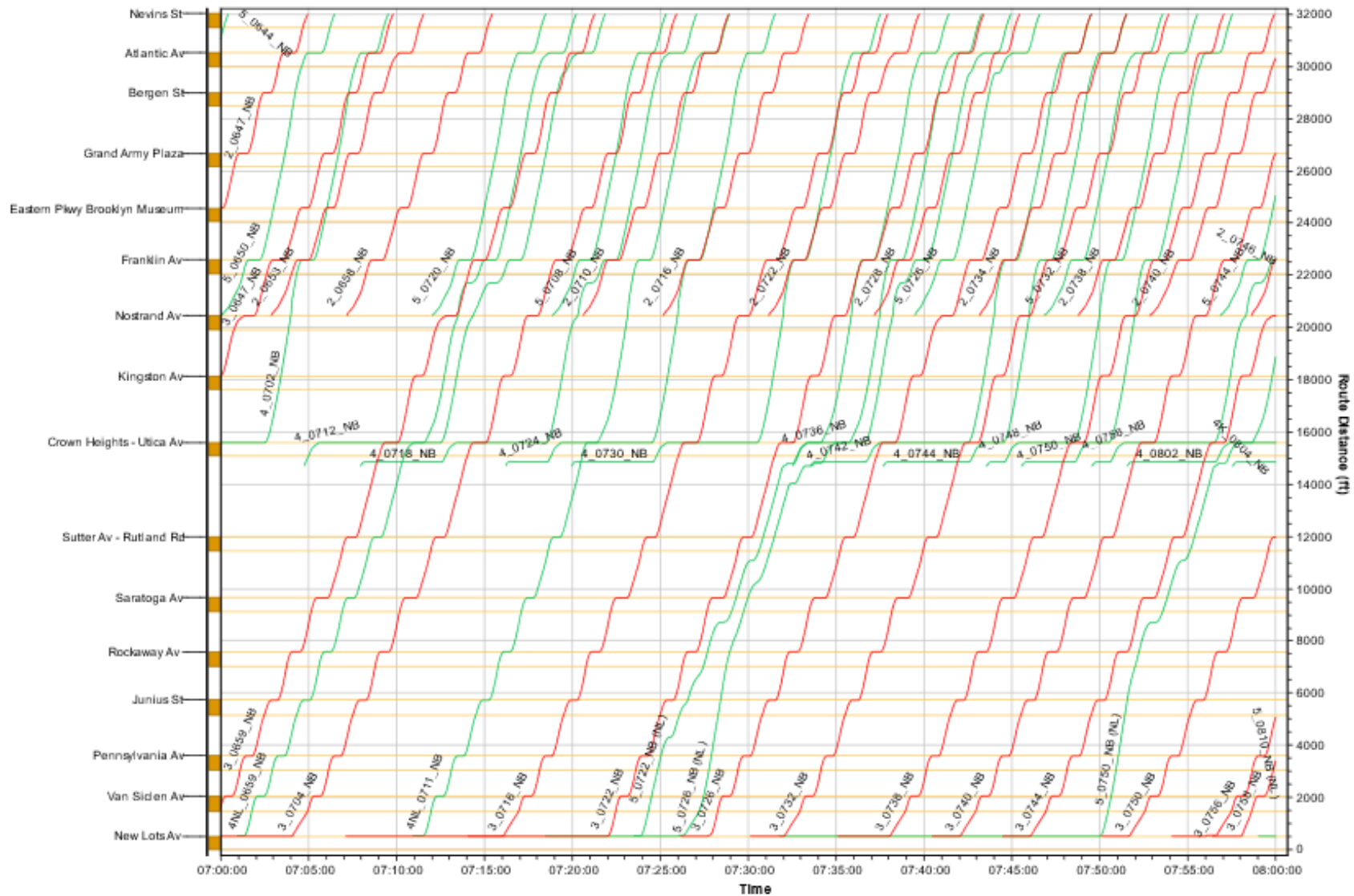
G.4.3 Nevins Street to New Lots Avenue

Figure G.4-33: Future Baseline (CBTC) String Chart - New Lots Avenue to Nevins Street – Northbound - 6:00 to 7:00 a.m.



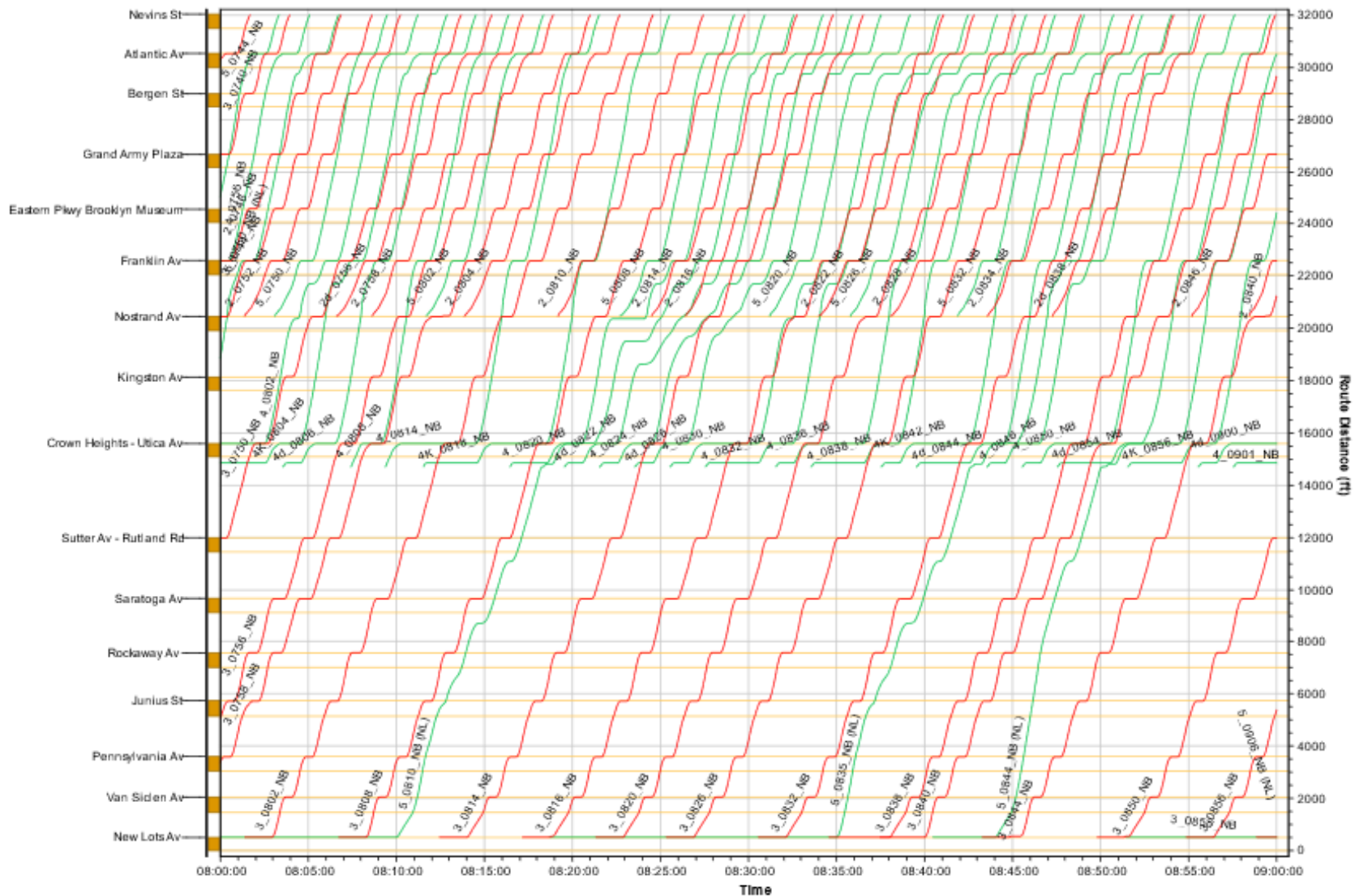
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Figure G.4-34: Future Baseline (CBTC) String Chart - New Lots Avenue to Nevins Street – Northbound - 7:00 to 8:00 a.m.



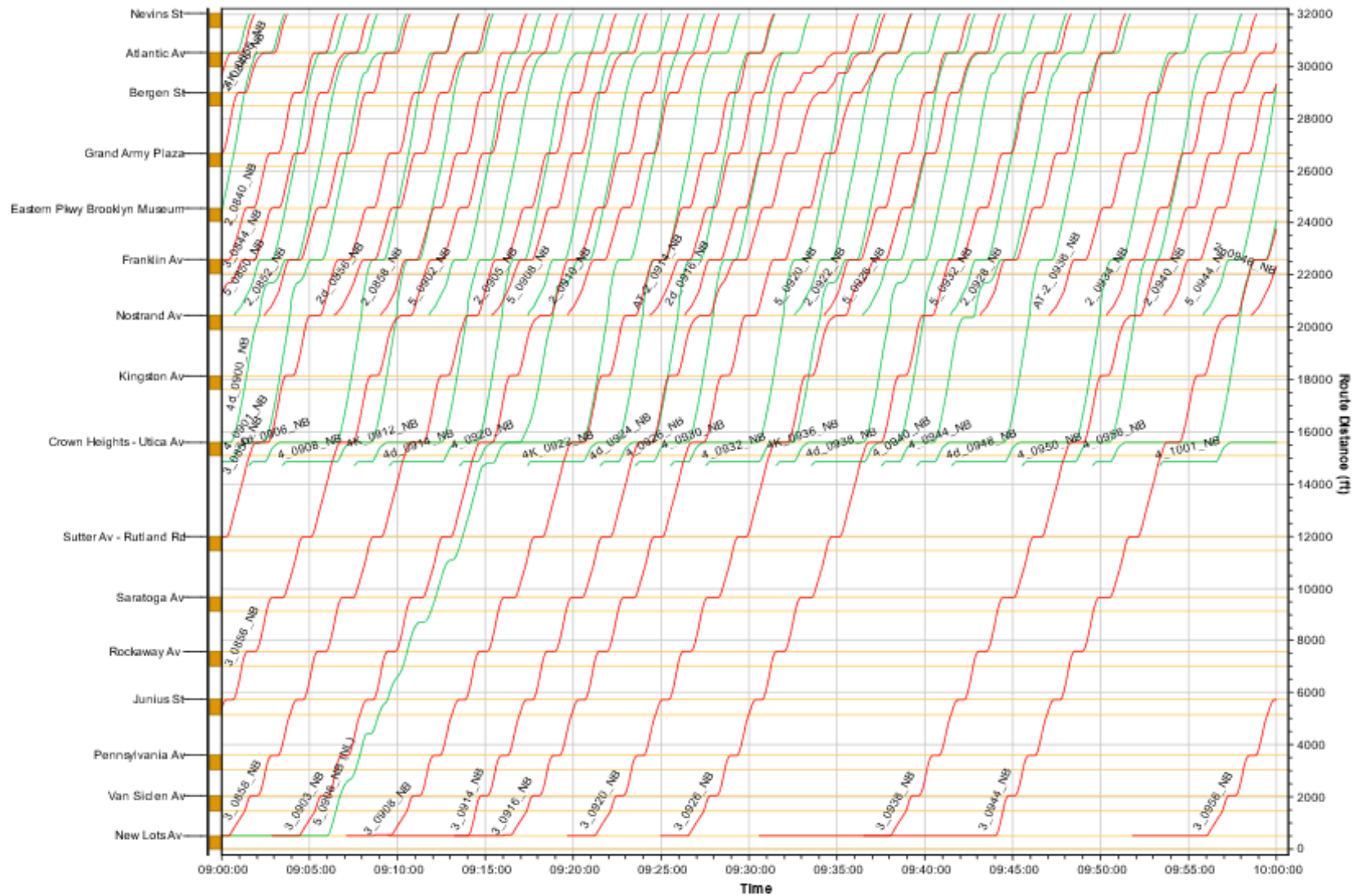
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-35: Future Baseline (CBTC) String Chart - New Lots Avenue to Nevins Street – Northbound - 8:00 to 9:00 a.m.



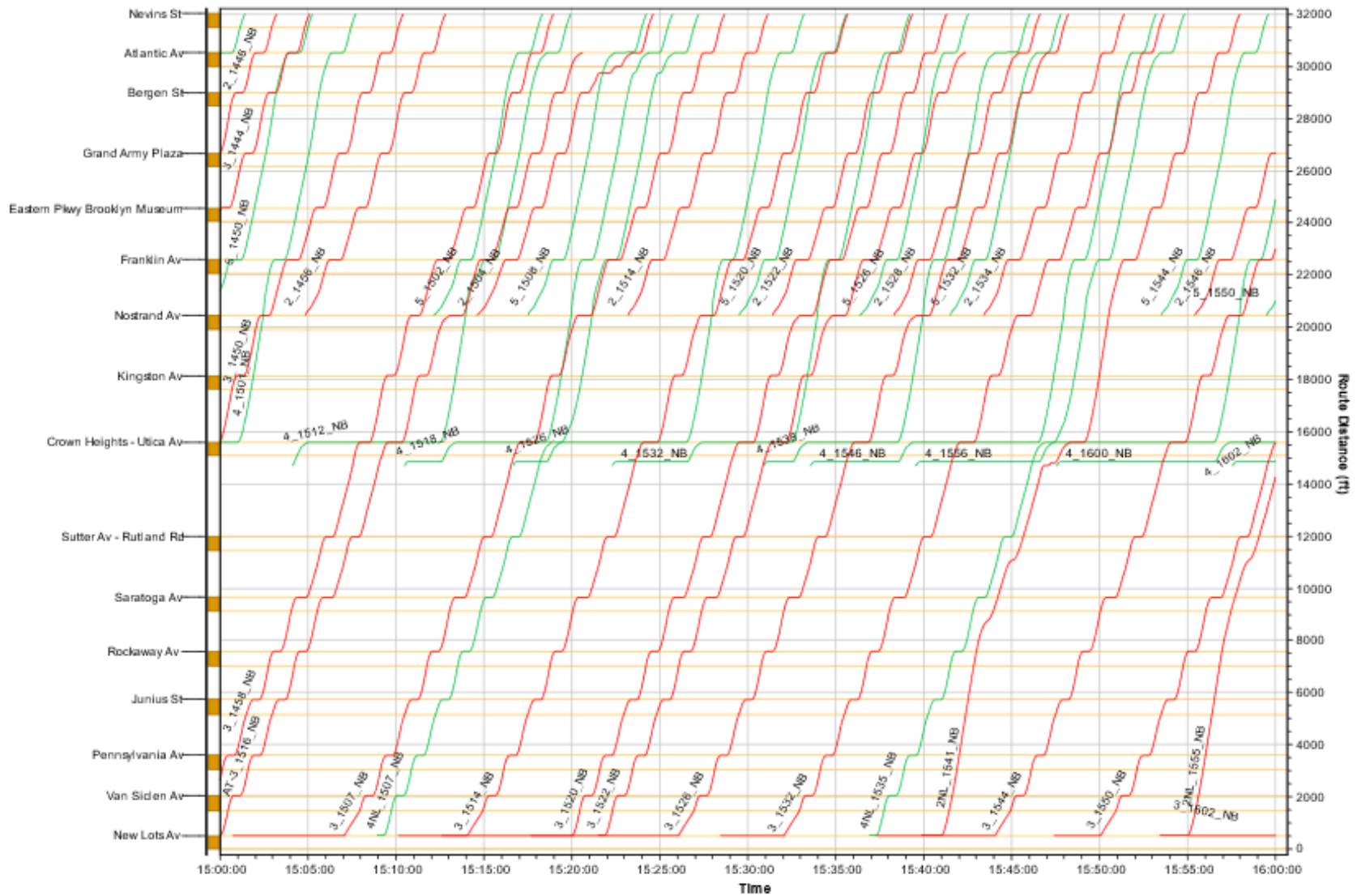
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-36: Future Baseline (CBTC) String Chart - New Lots Avenue to Nevins Street – Northbound - 9:00 to 10:00 a.m.



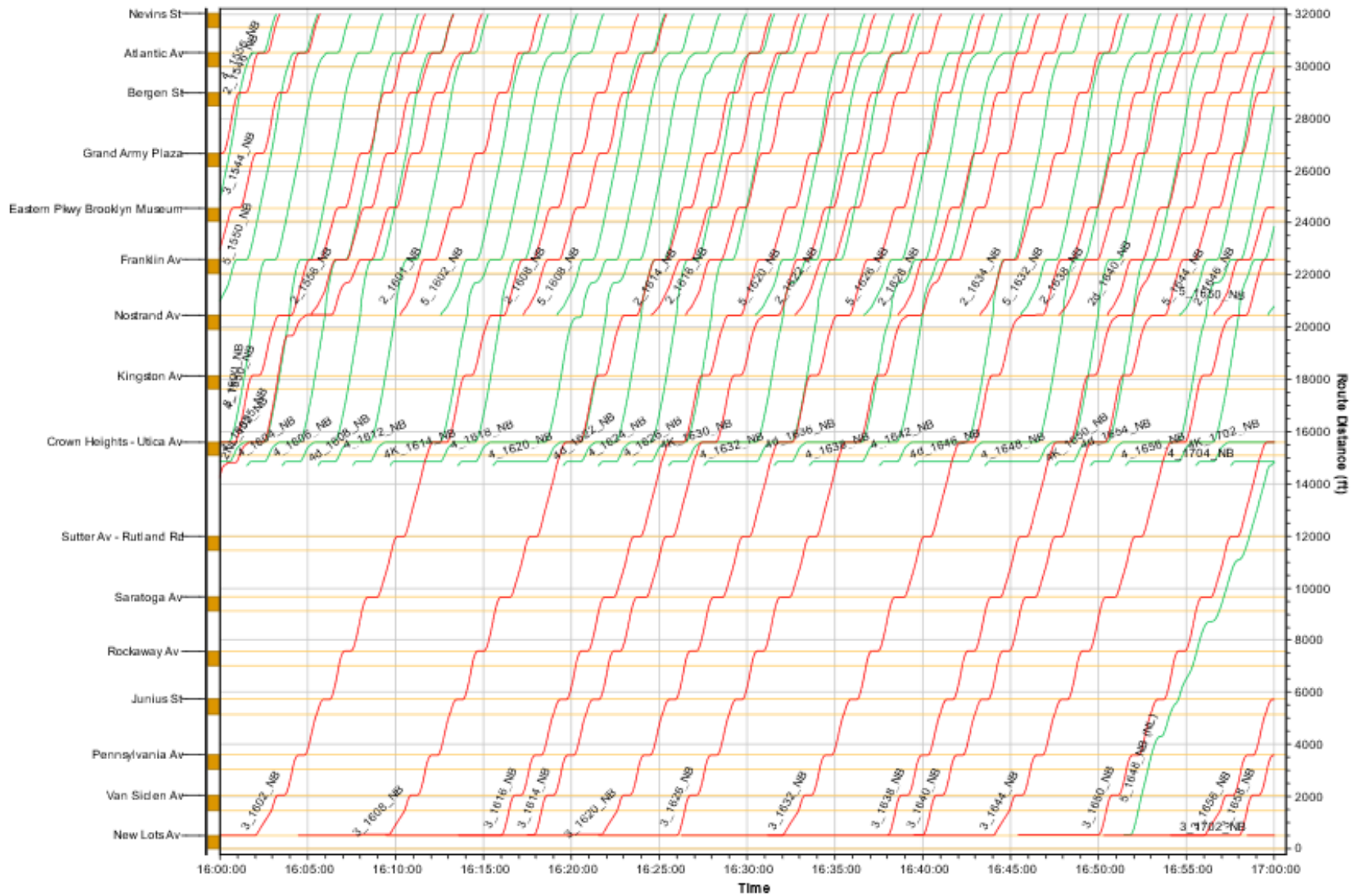
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-37: Future Baseline (CBTC) String Chart - New Lots Avenue to Nevins Street – Northbound - 3:00 to 4:00 p.m.



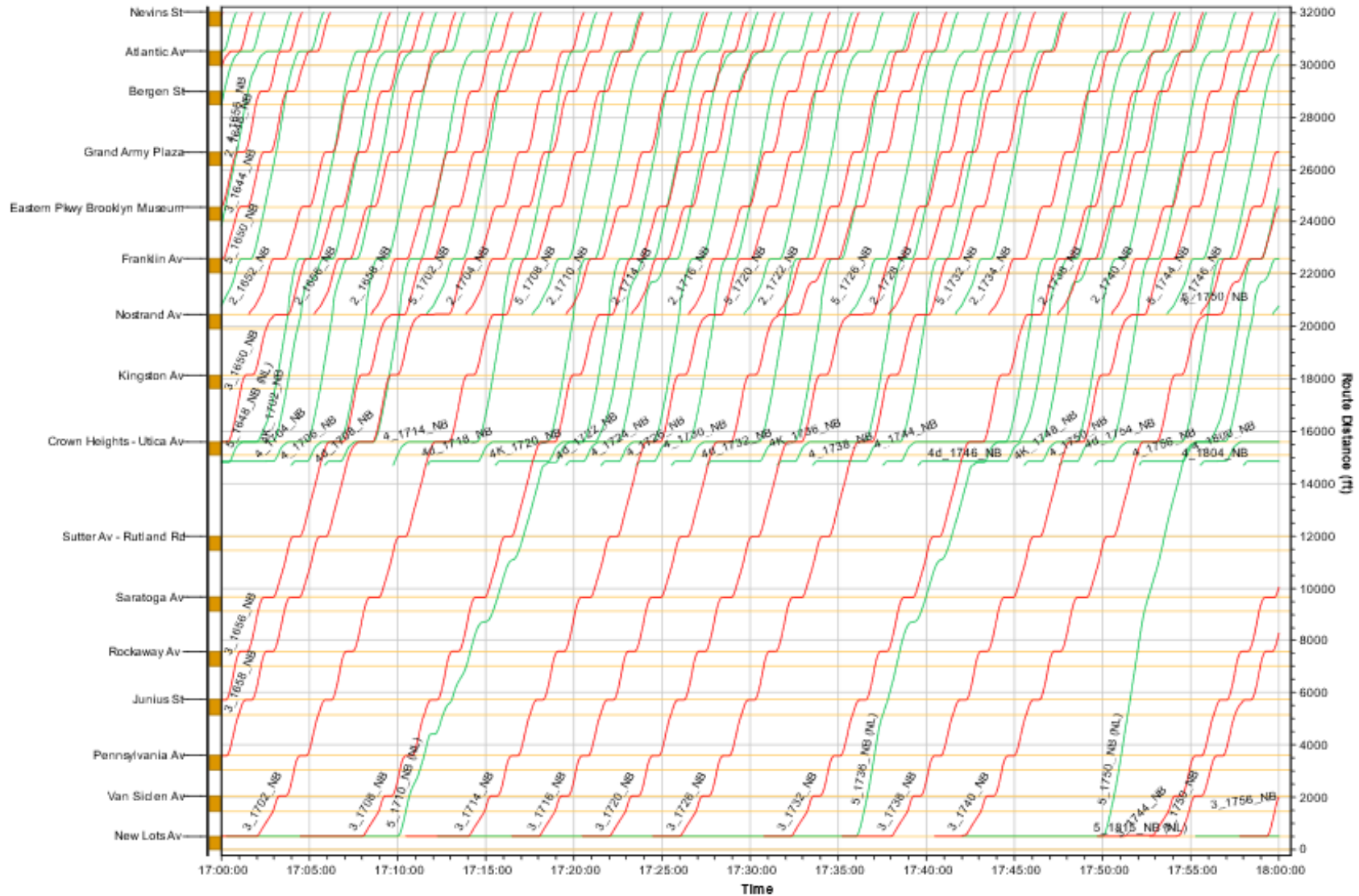
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-38: Future Baseline (CBTC) String Chart - New Lots Avenue to Nevins Street – Northbound - 4:00 to 5:00 p.m.



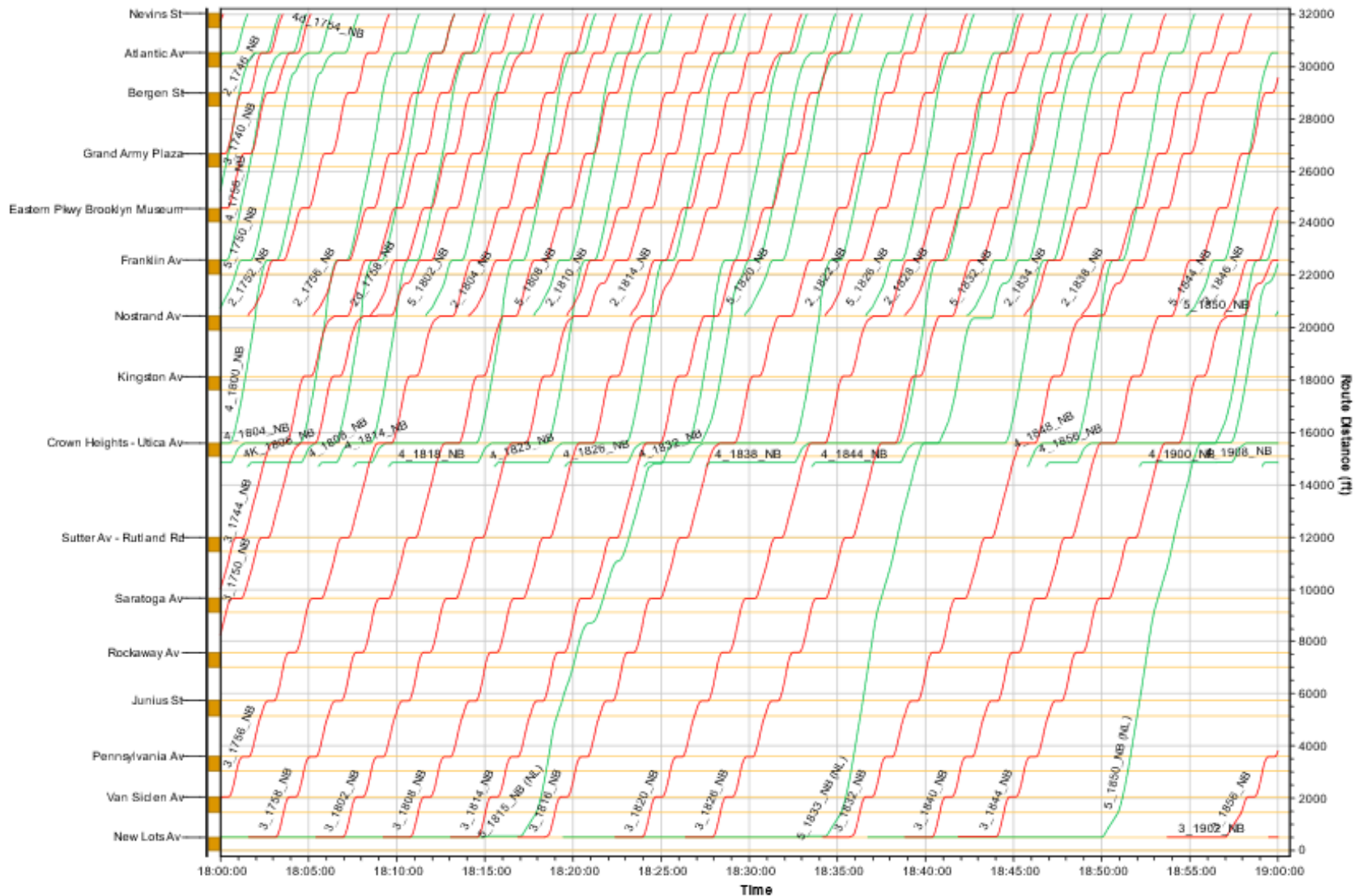
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-39: Future Baseline (CBTC) String Chart - New Lots Avenue to Nevins Street – Northbound - 5:00 to 6:00 p.m.



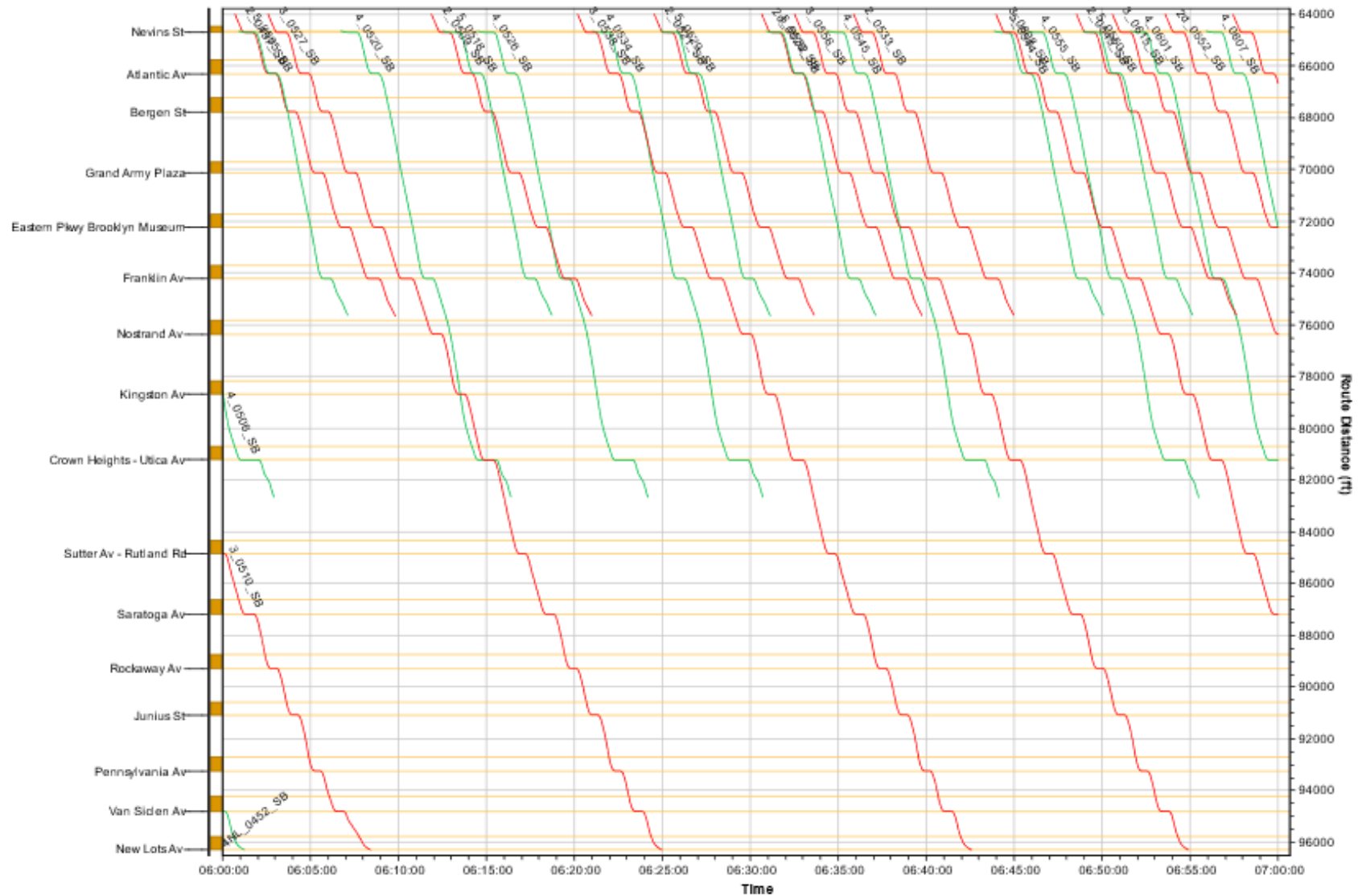
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-40: Future Baseline (CBTC) String Chart - New Lots Avenue to Nevins Street – Northbound - 6:00 to 7:00 p.m.



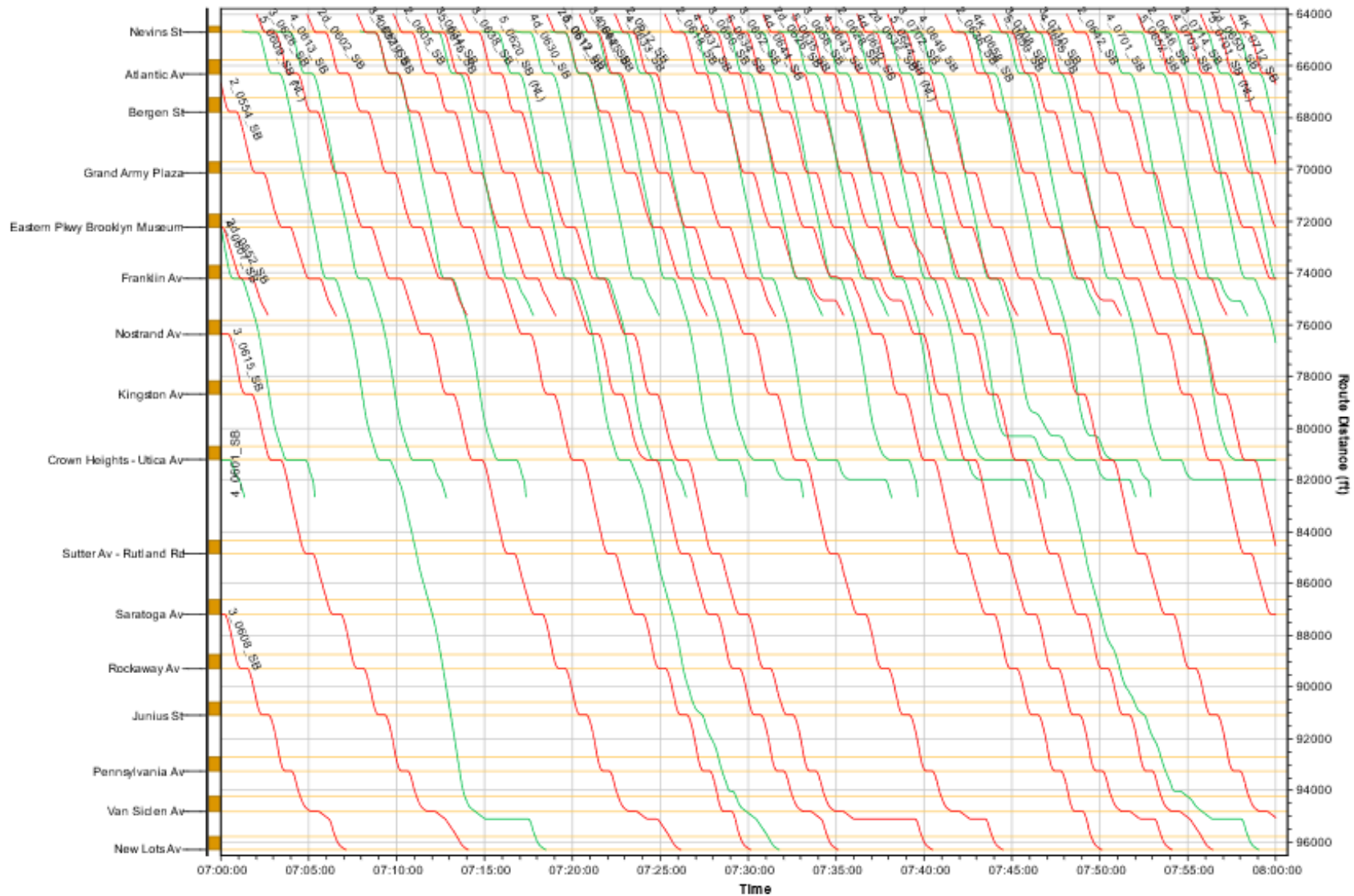
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-41: Future Baseline (CBTC) String Chart - Nevins Street to New Lots Avenue - Southbound - 6:00 to 7:00 a.m.



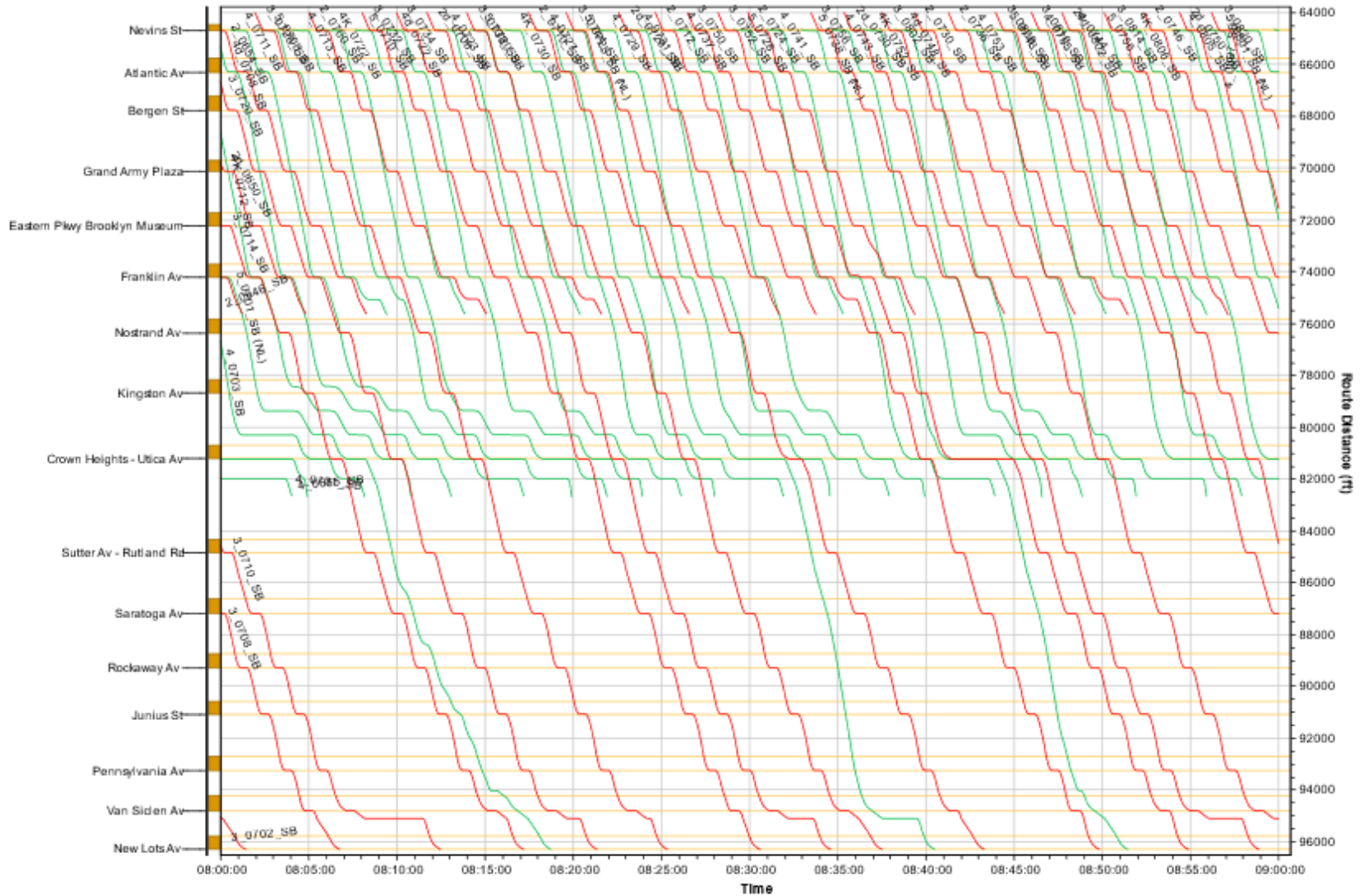
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-42: Future Baseline (CBTC) String Chart - Nevins Street to New Lots Avenue - Southbound - 7:00 to 8:00 a.m.



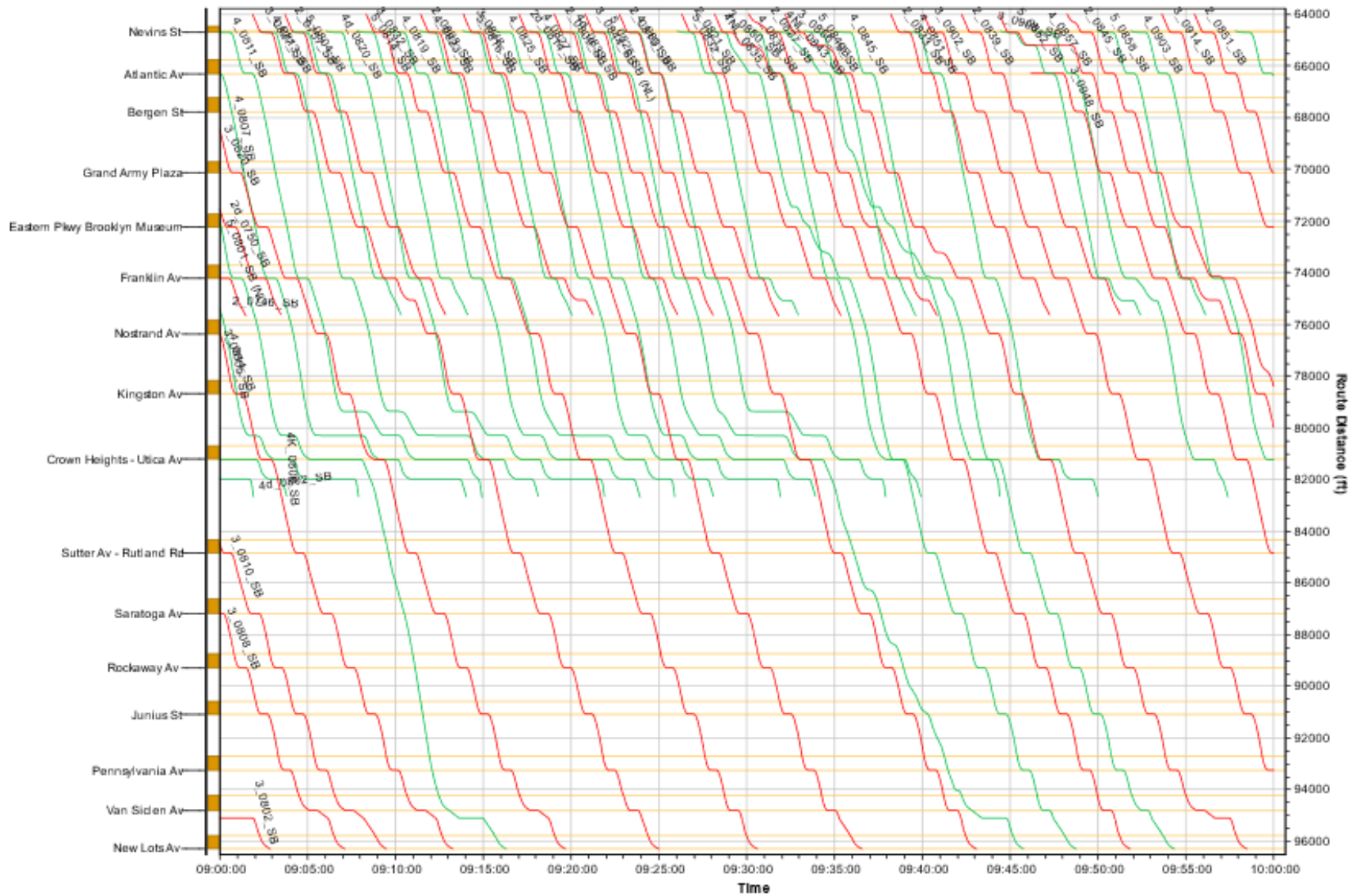
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-43: Future Baseline (CBTC) String Chart - Nevins Street to New Lots Avenue - Southbound - 8:00 to 9:00 a.m.



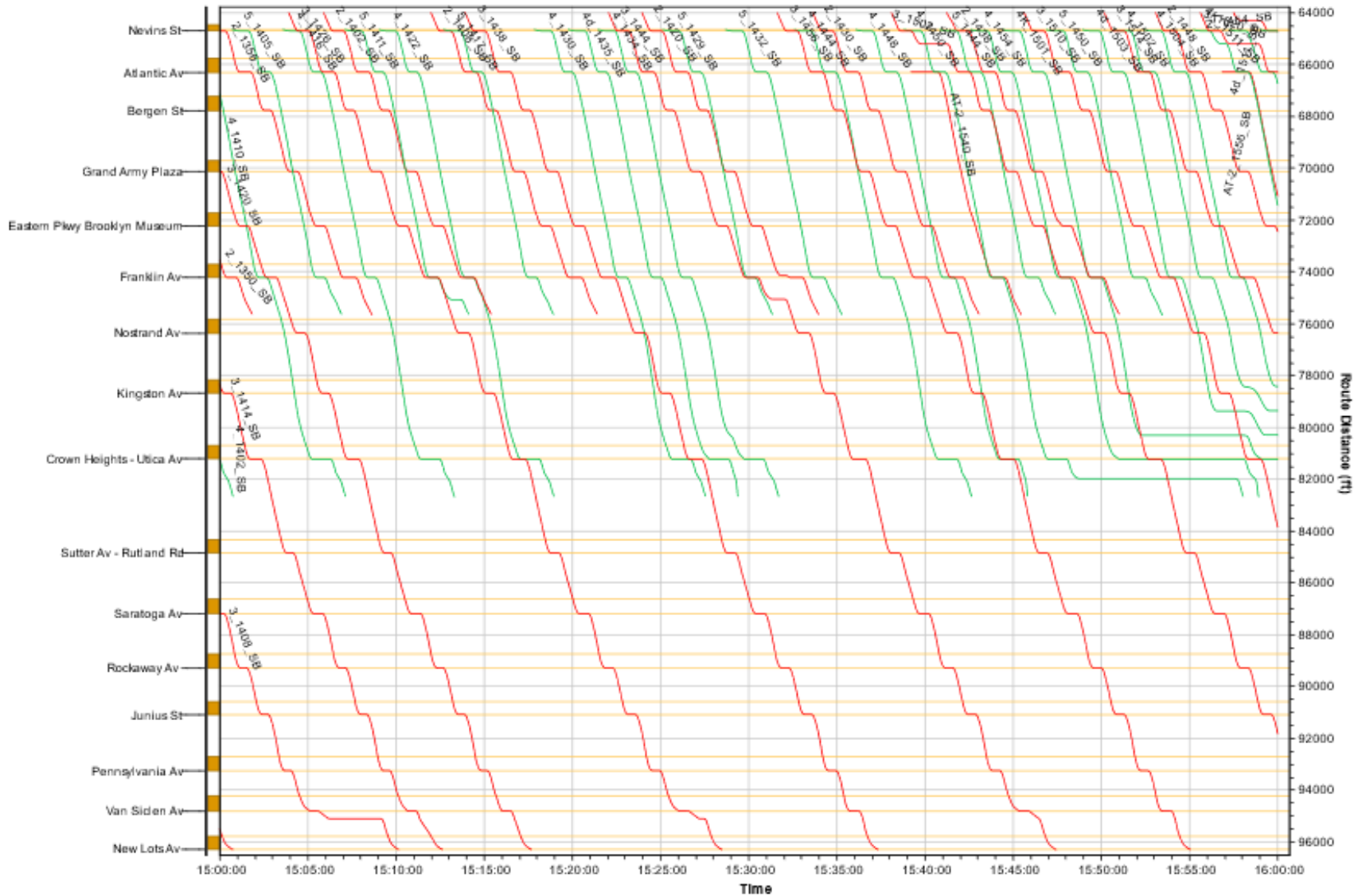
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-44: Future Baseline (CBTC) String Chart - Nevins Street to New Lots Avenue - Southbound - 9:00 to 10:00 a.m.



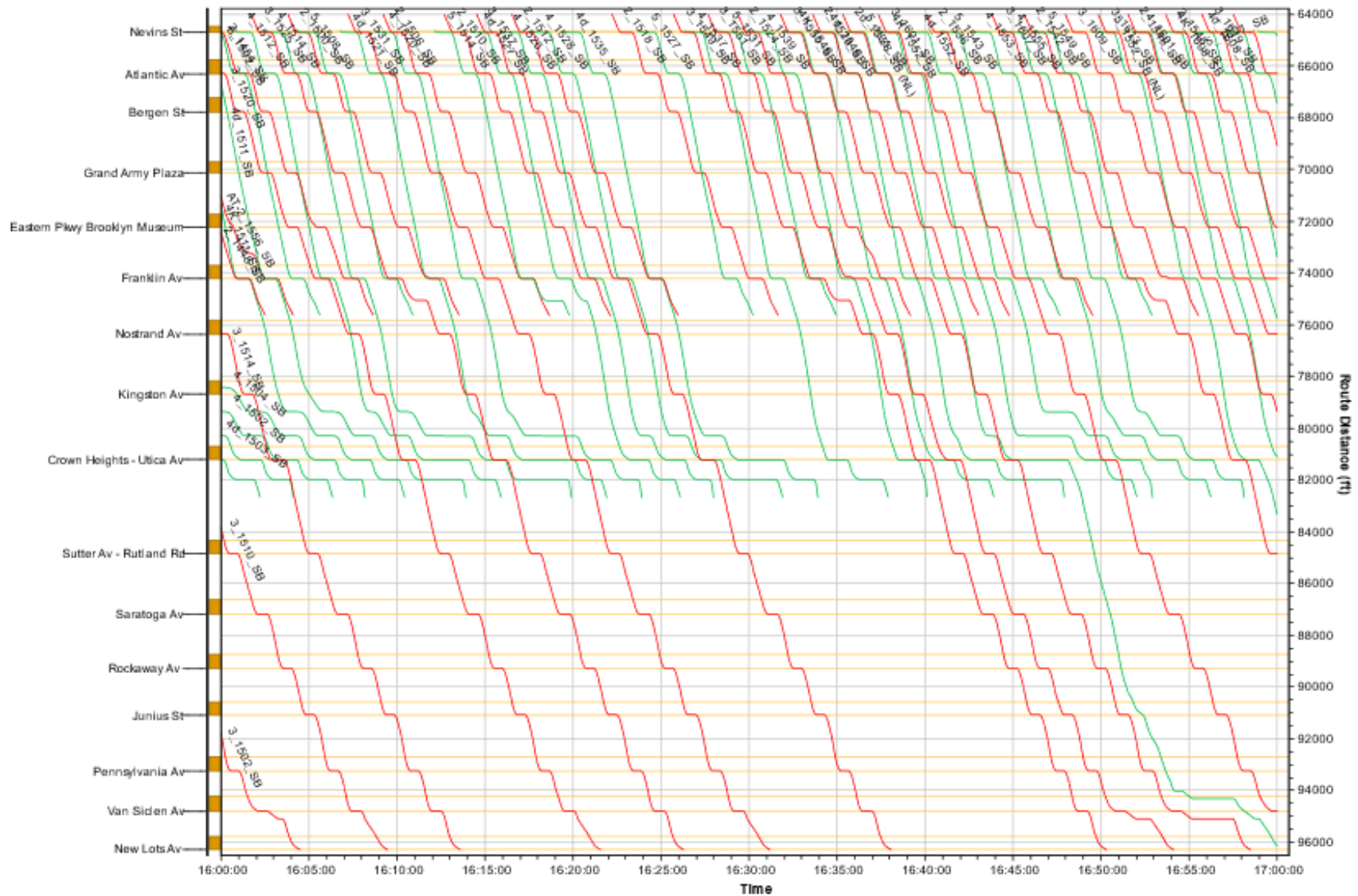
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-45: Future Baseline (CBTC) String Chart - Nevins Street to New Lots Avenue - Southbound - 3:00 to 4:00 p.m.



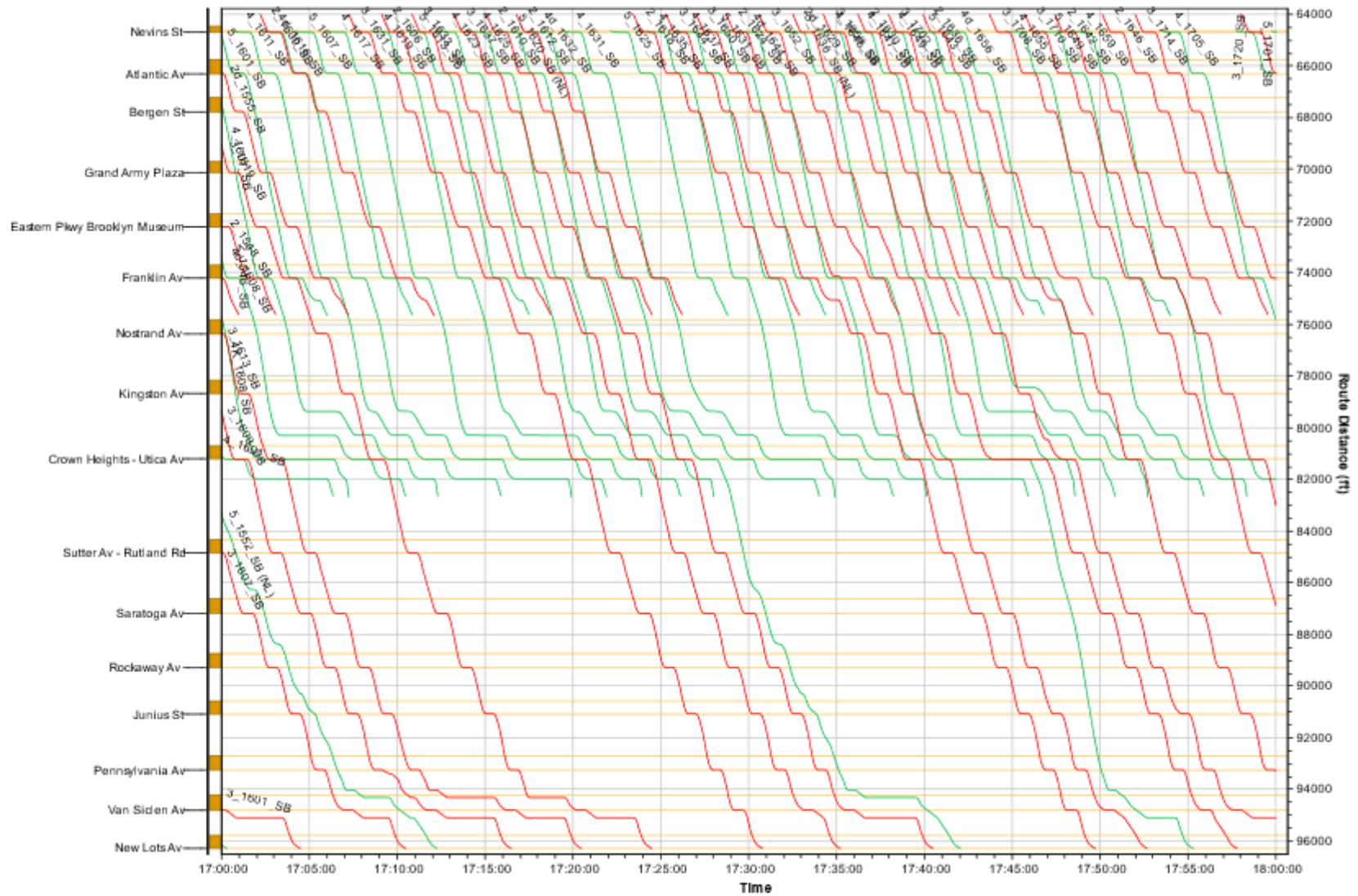
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-46: Future Baseline (CBTC) String Chart - Nevins Street to New Lots Avenue - Southbound - 4:00 to 5:00 p.m.



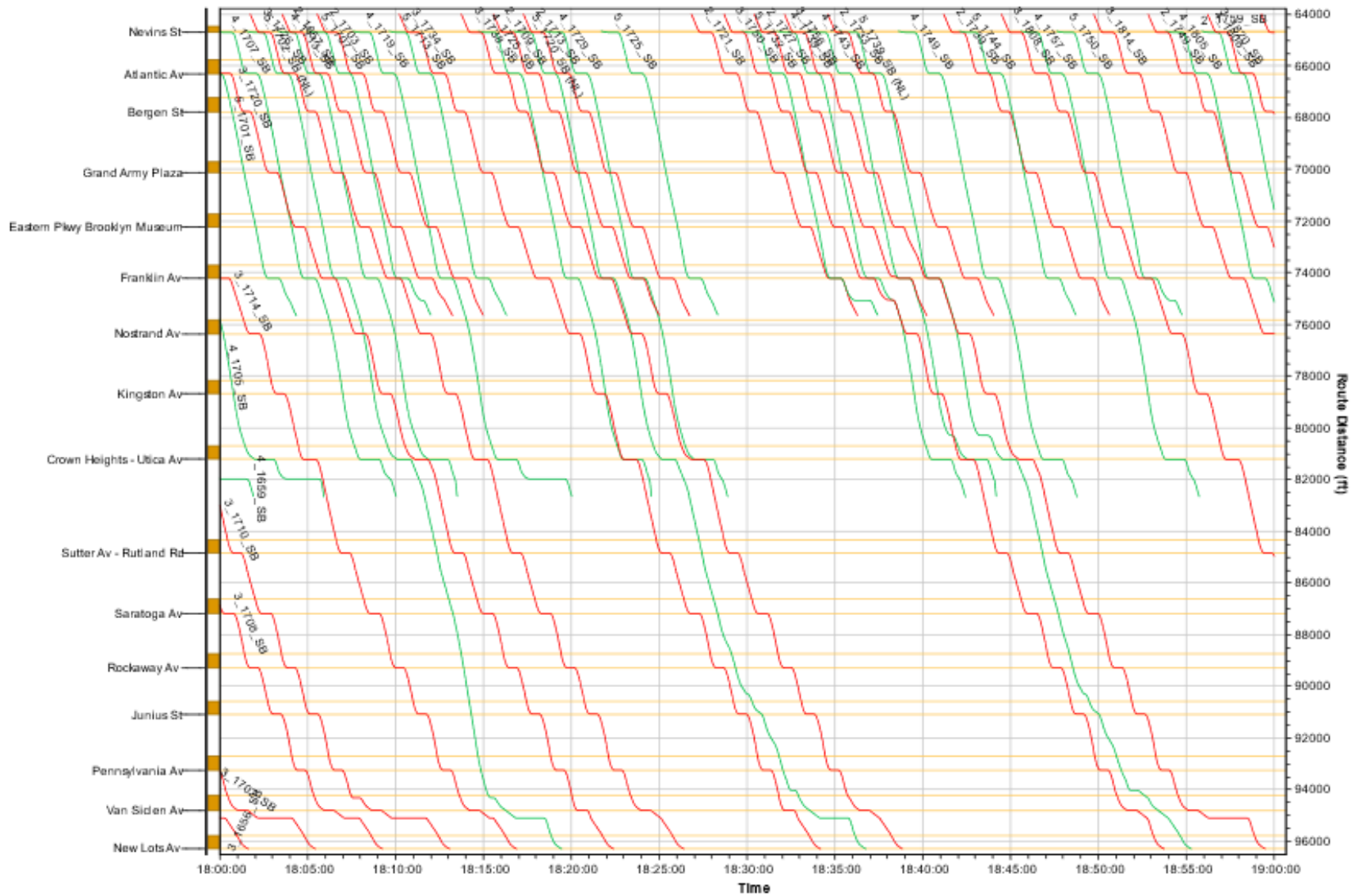
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Figure G.4-47: Future Baseline (CBTC) String Chart - Nevins Street to New Lots Avenue - Southbound - 5:00 to 6:00 p.m.



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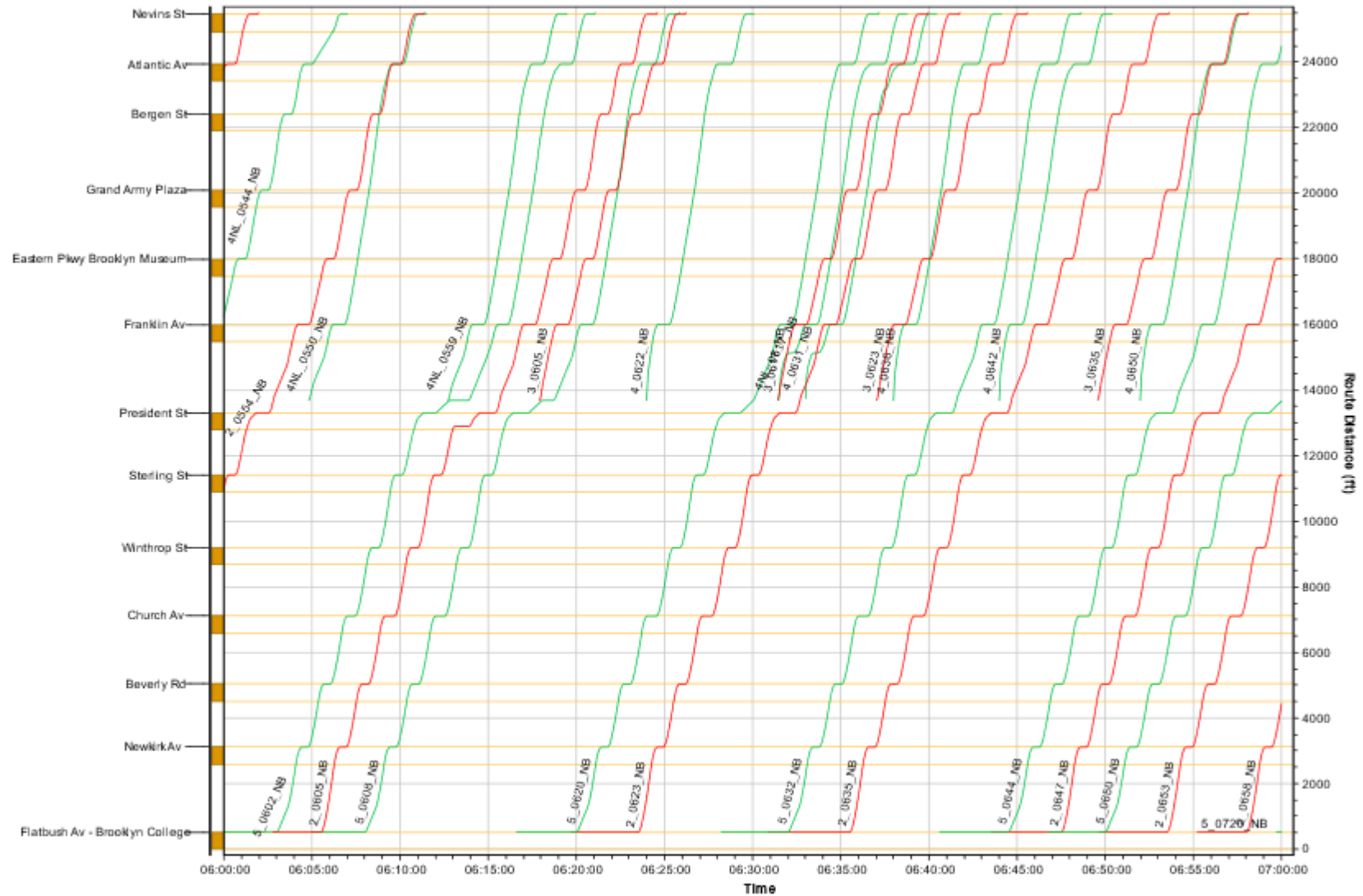
Figure G.4-48: Future Baseline (CBTC) String Chart - Nevins Street to New Lots Avenue - Southbound - 6:00 to 7:00 p.m.



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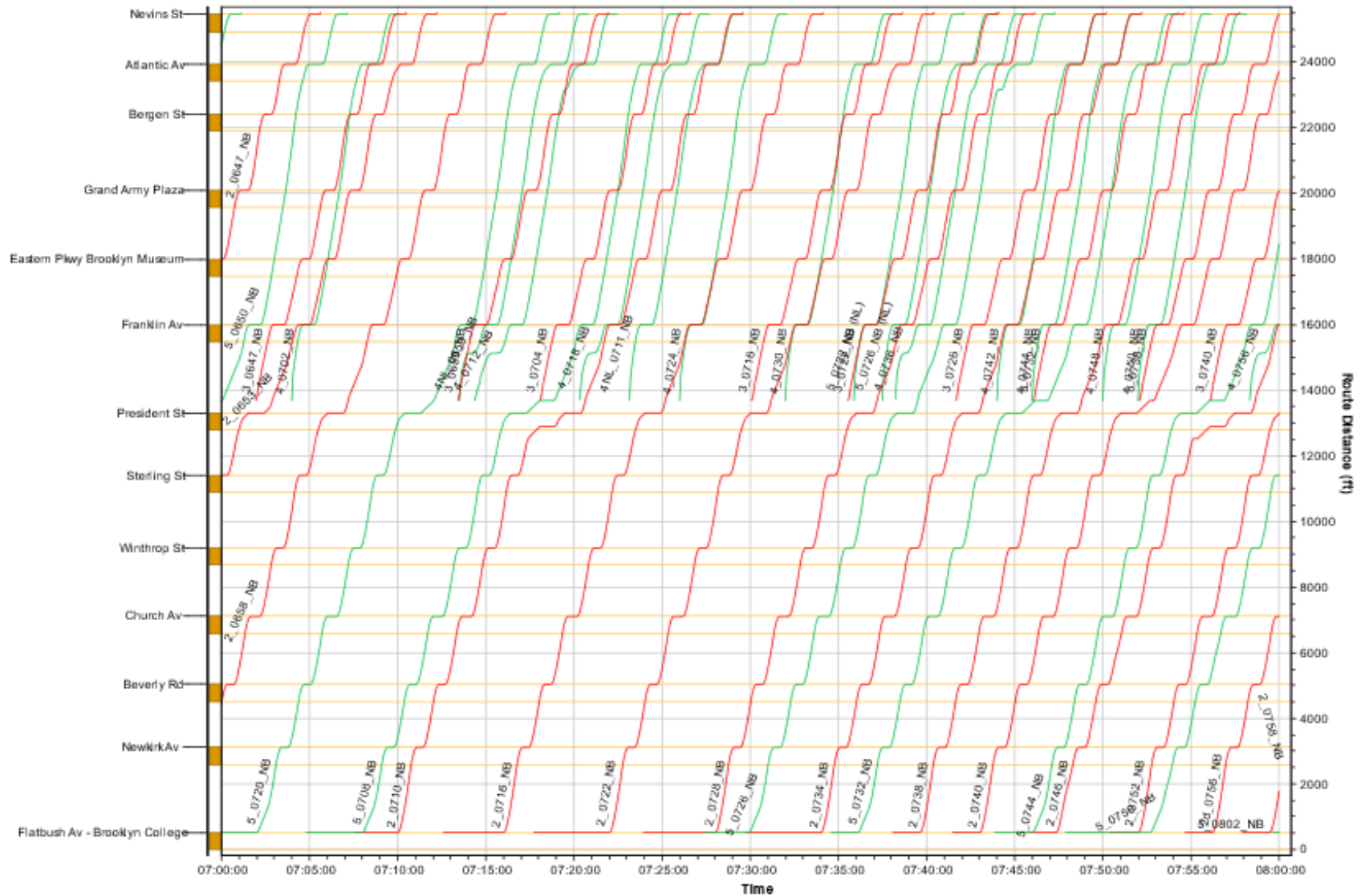
G.4.4 Nevins Street to Flatbush Avenue/Brooklyn College

Figure G.4-49: Future Baseline (CBTC) String Chart - Flatbush Avenue/Brooklyn College to Nevins Street - Northbound - 6:00 to 7:00 a.m.



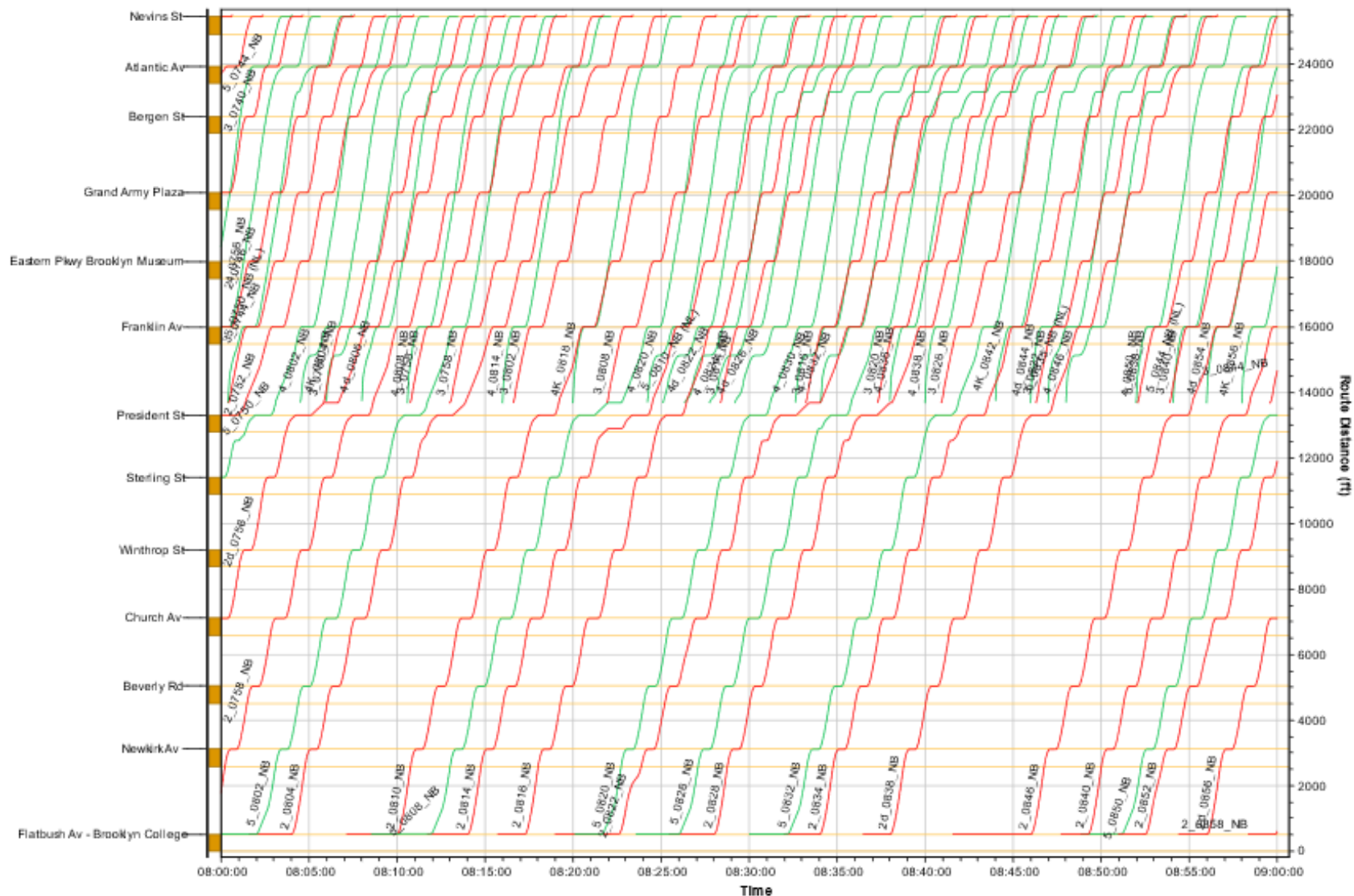
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-50: Future Baseline (CBTC) String Chart - Flatbush Avenue/Brooklyn College to Nevins Street - Northbound - 7:00 to 8:00 a.m.



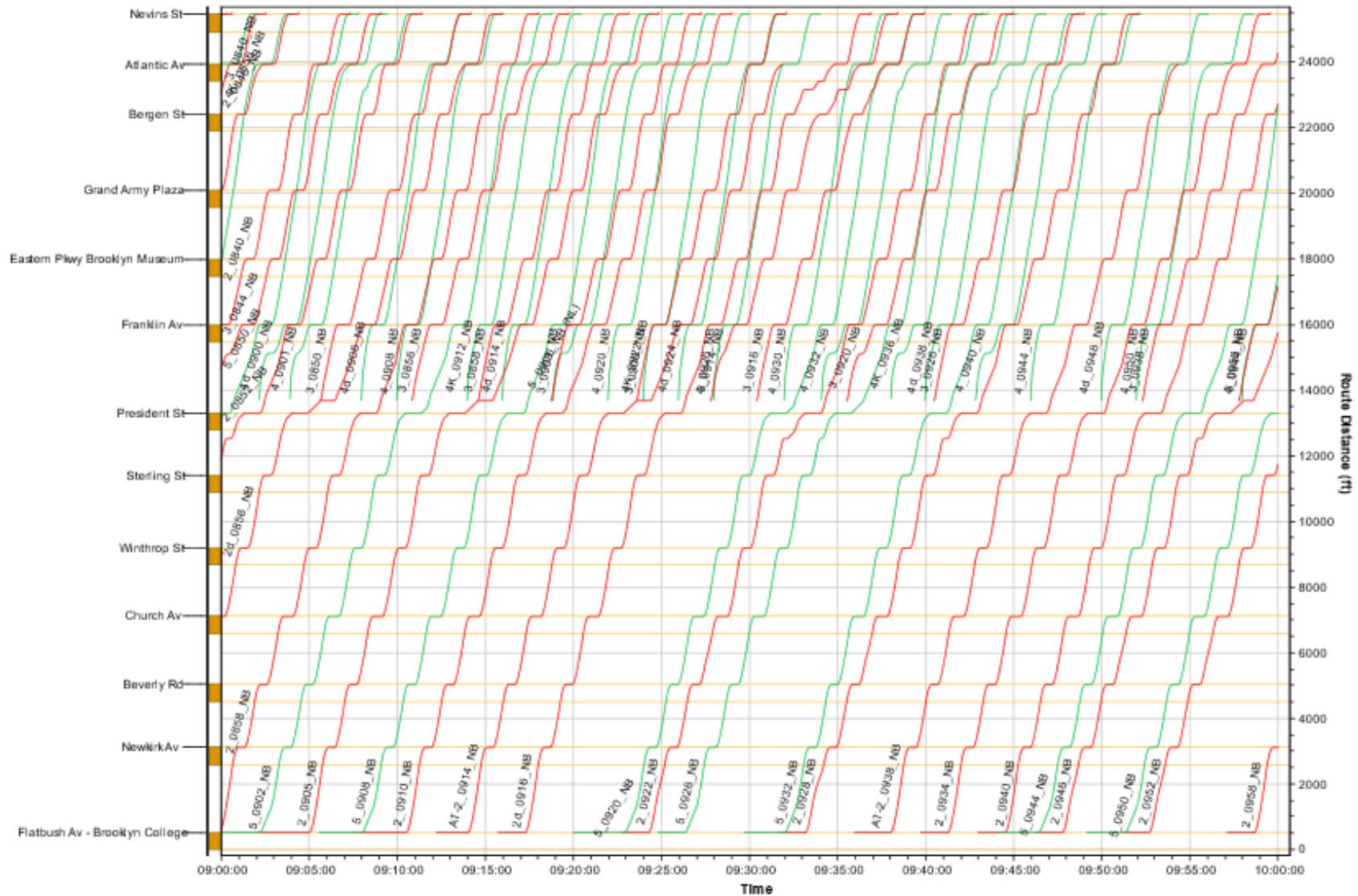
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-51: Future Baseline (CBTC) String Chart - Flatbush Avenue/Brooklyn College to Nevins Street - Northbound - 8:00 to 9:00 a.m.



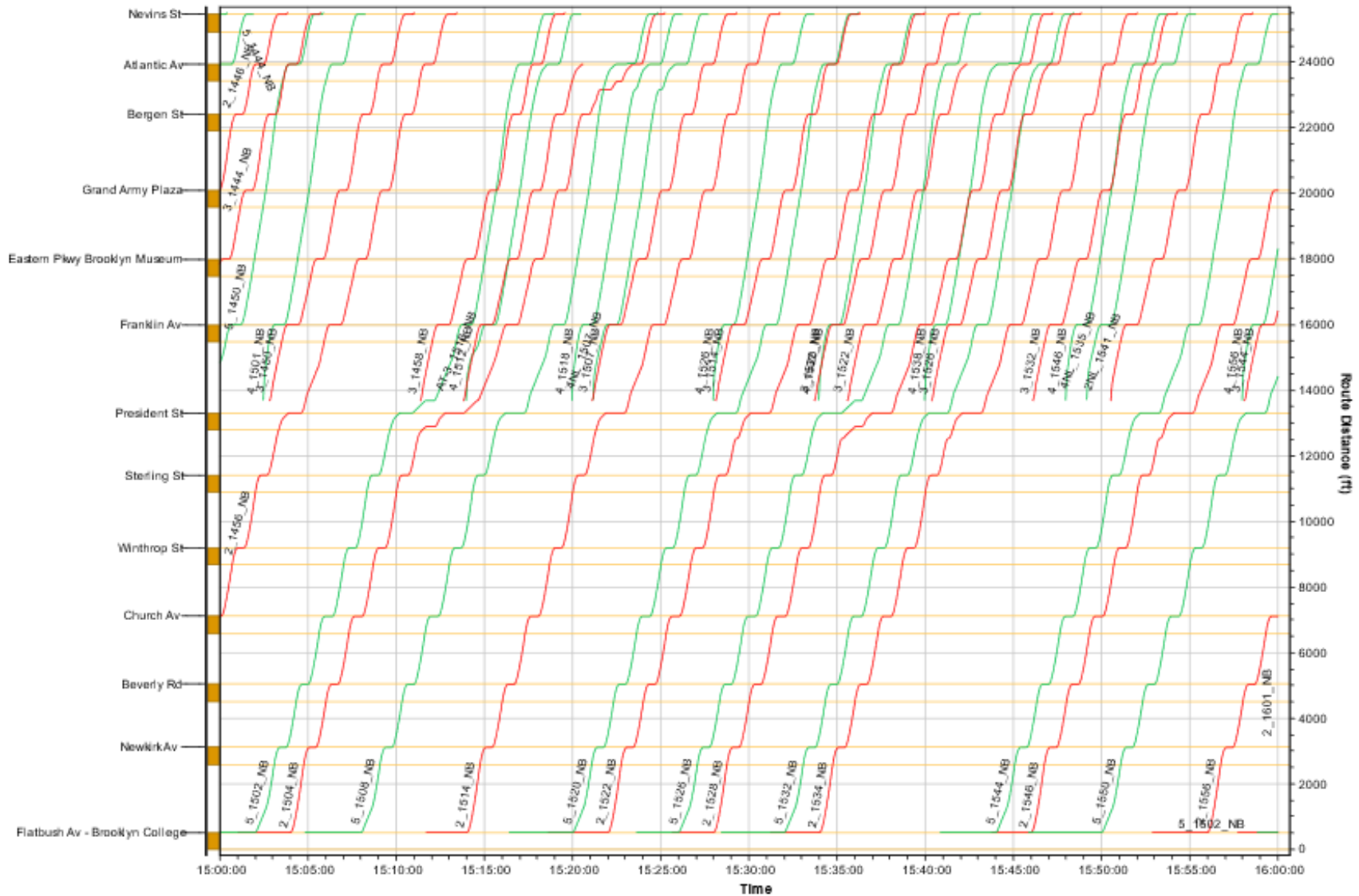
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-52: Future Baseline (CBTC) String Chart - Flatbush Avenue/Brooklyn College to Nevins Street - Northbound - 9:00 to 10:00 a.m.



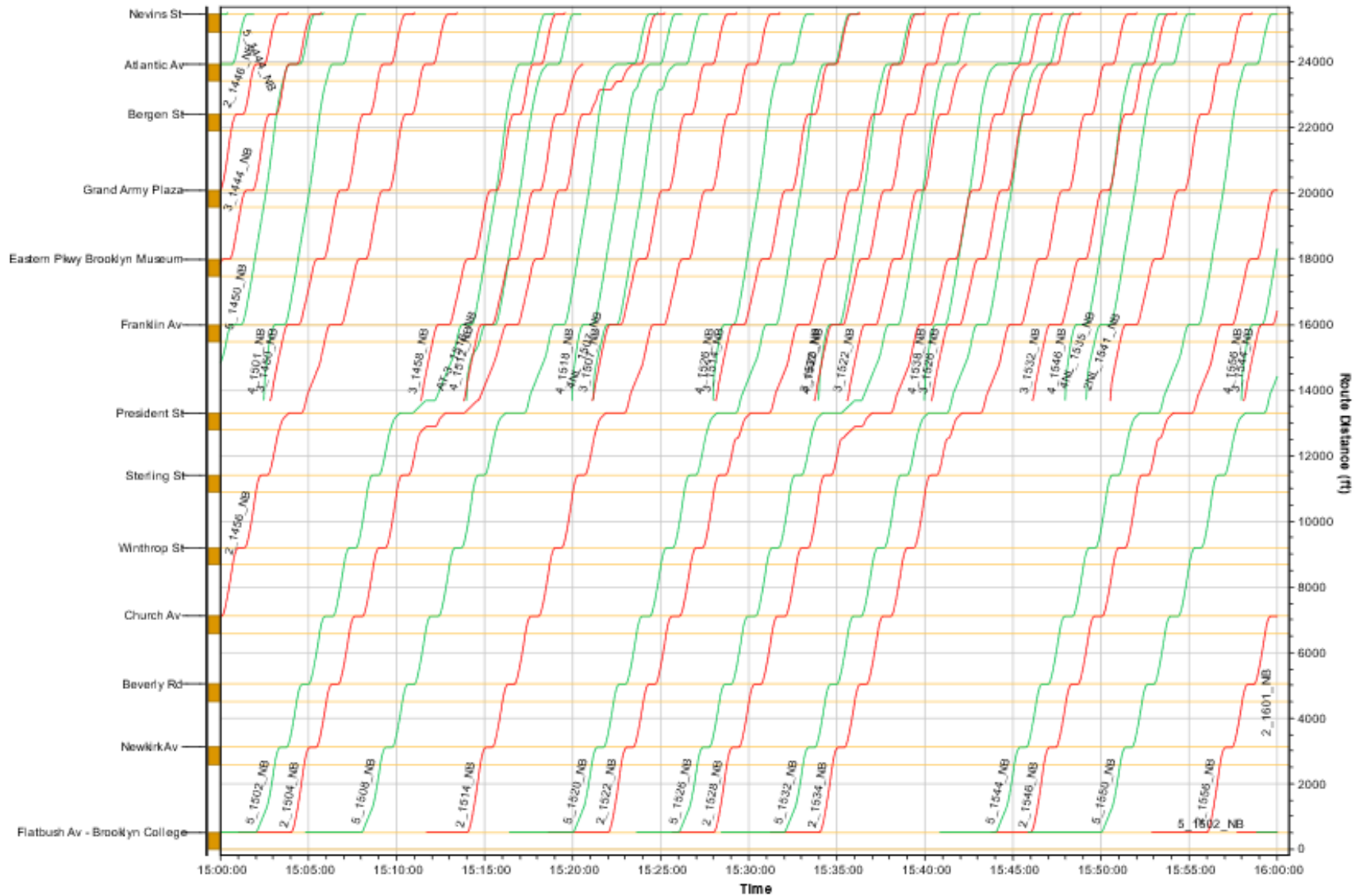
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Figure G.4-53: Future Baseline (CBTC) String Chart - Flatbush Avenue/Brooklyn College to Nevins Street - Northbound - 3:00 to 4:00 p.m.



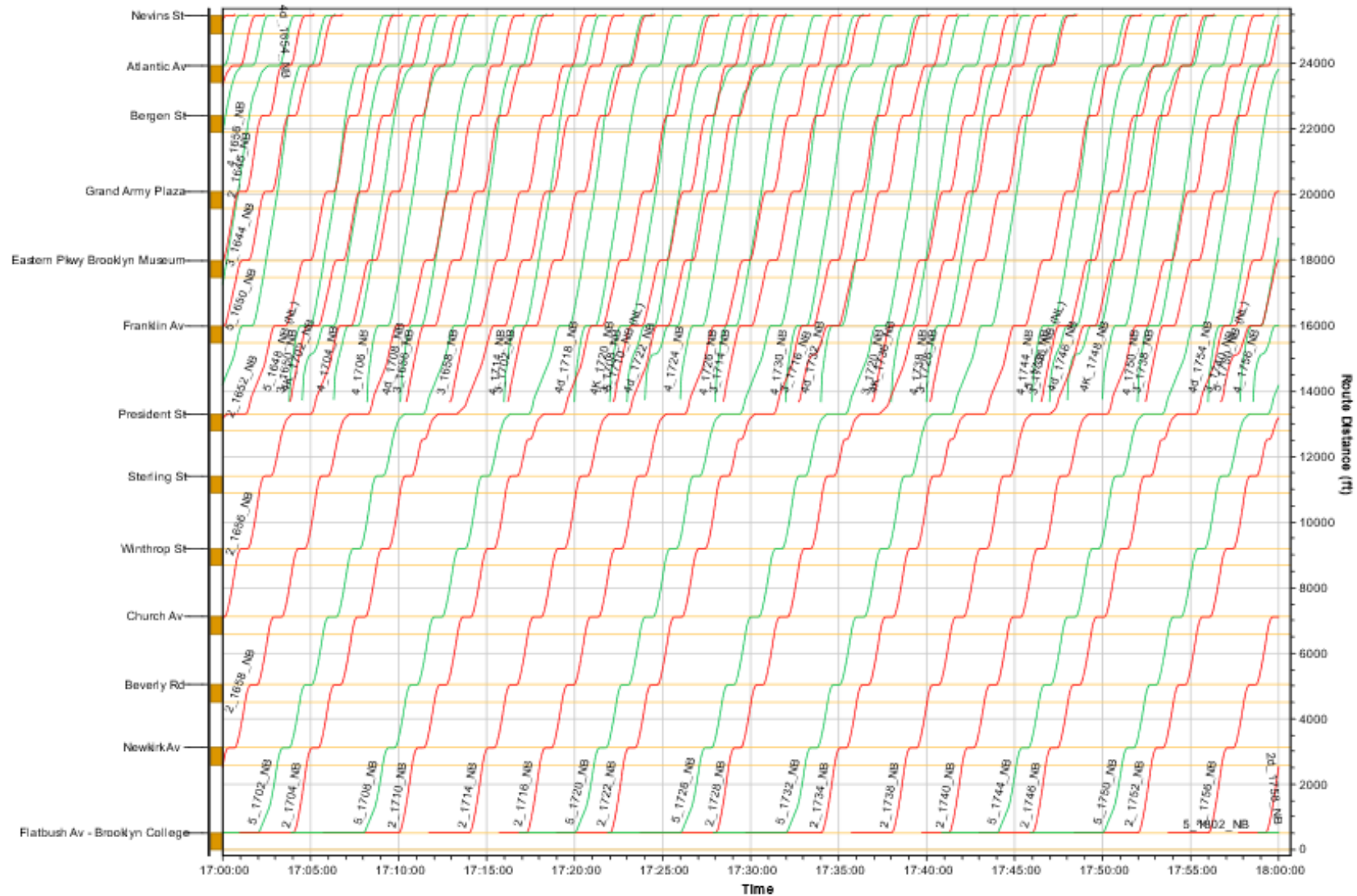
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-54: Future Baseline (CBTC) String Chart - Flatbush Avenue/Brooklyn College to Nevins Street - Northbound - 4:00 to 5:00 p.m.



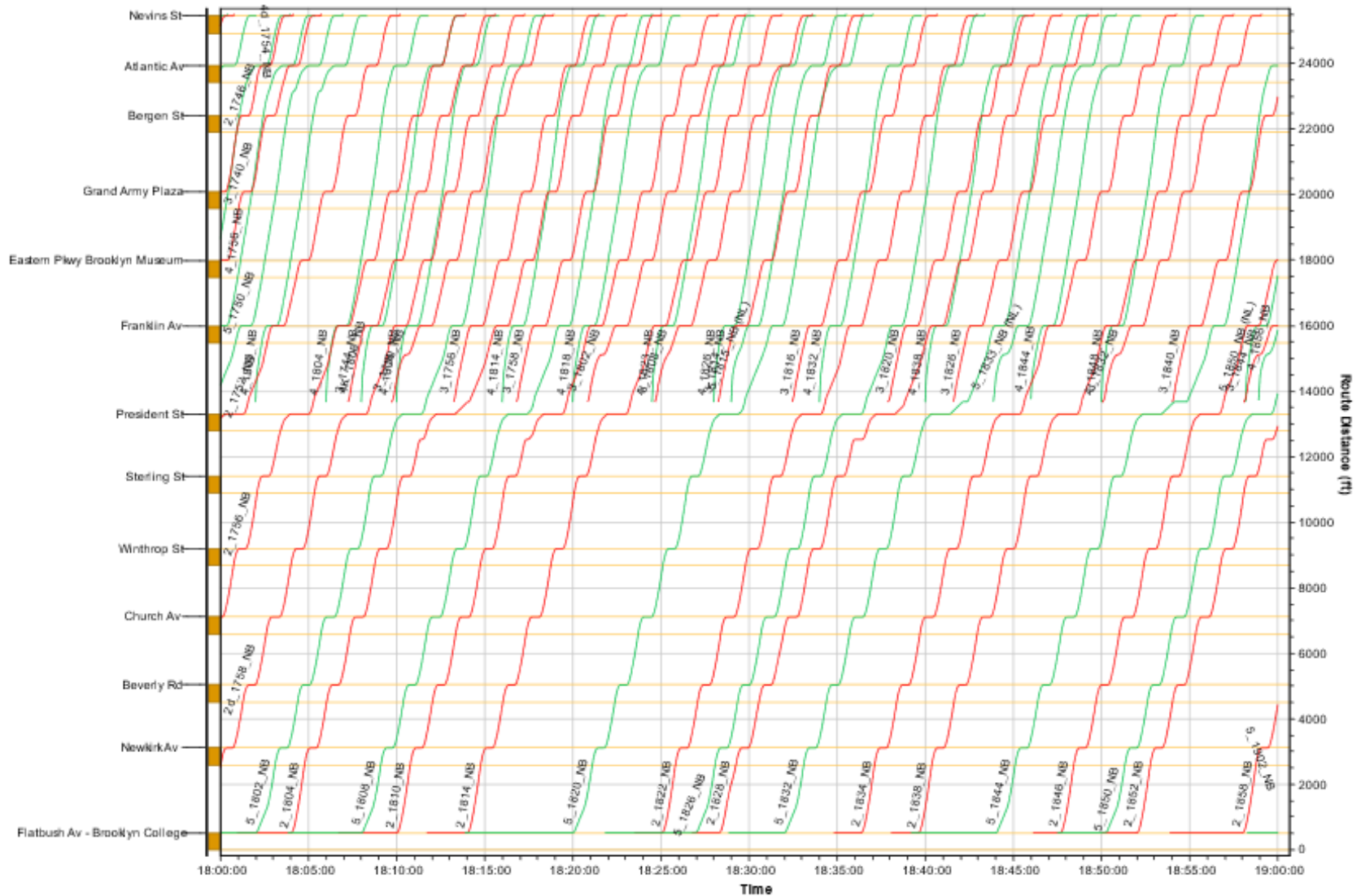
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-55: Future Baseline (CBTC) String Chart - Flatbush Avenue/Brooklyn College to Nevins Street - Northbound - 5:00 to 6:00 p.m.



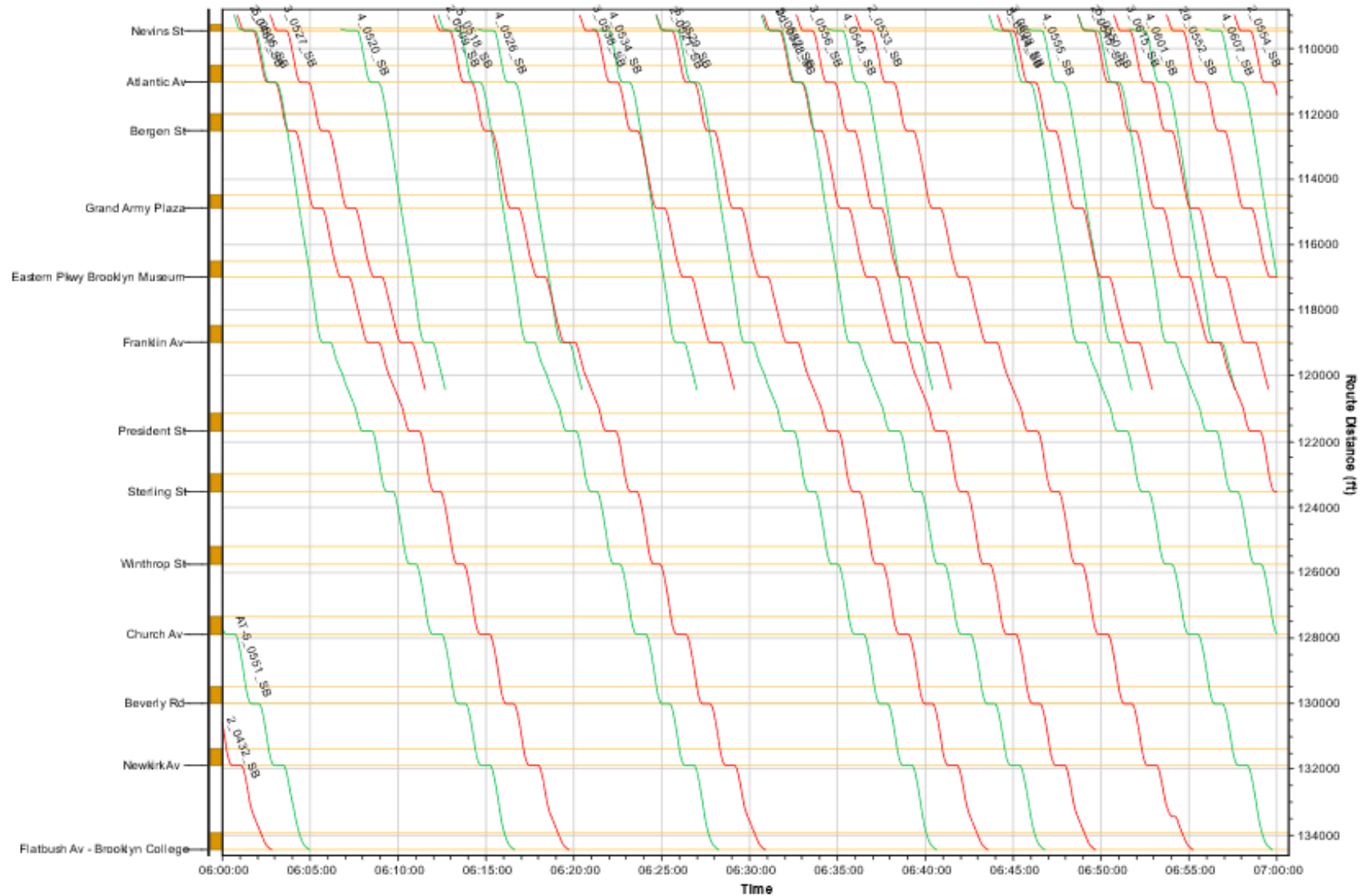
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-56: Future Baseline (CBTC) String Chart - Flatbush Avenue/Brooklyn College to Nevins Street - Northbound - 6:00 to 7:00 p.m.



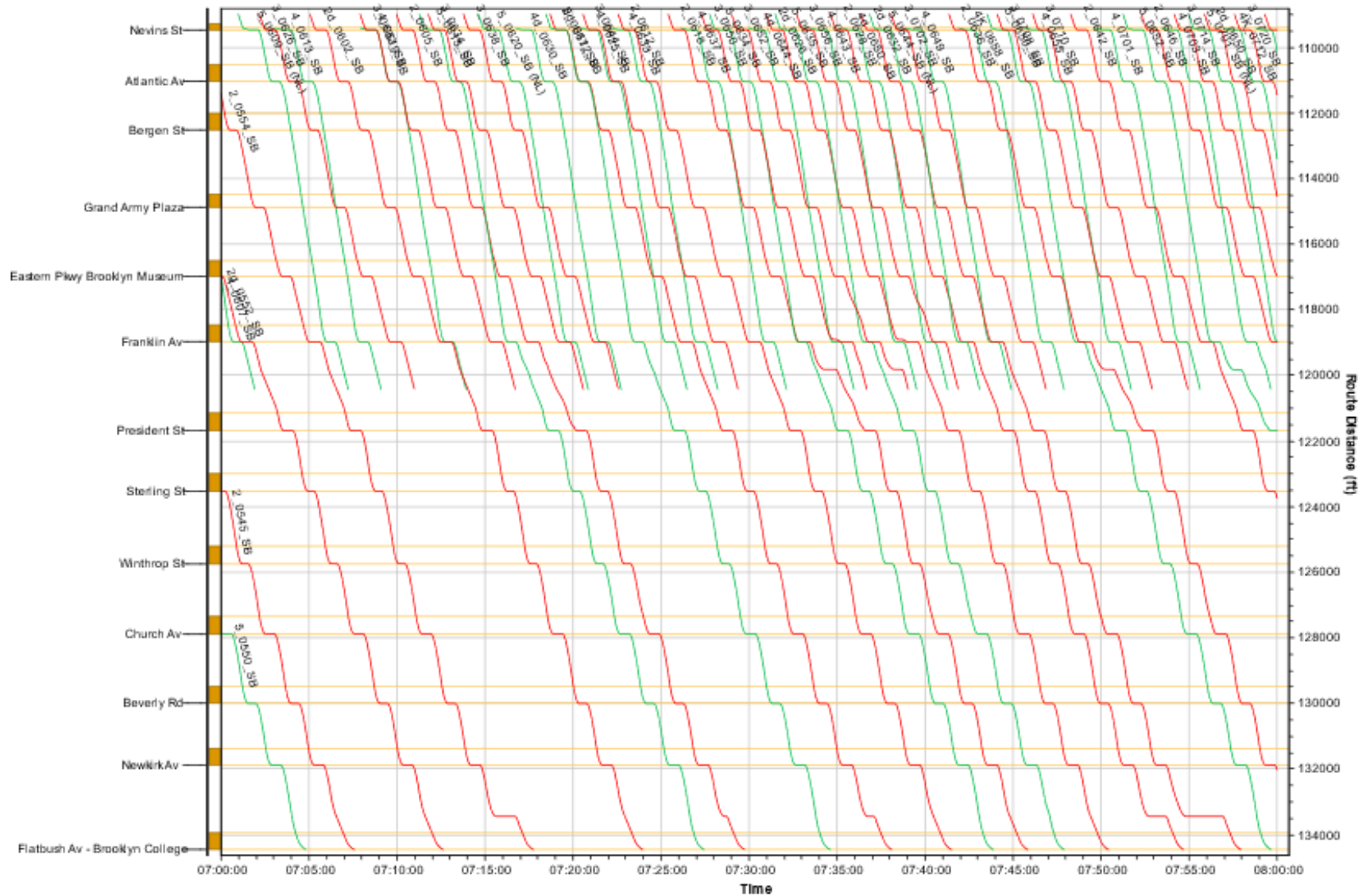
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-57: Future Baseline (CBTC) String Chart - Nevins Street to Flatbush Avenue/Brooklyn College - Southbound - 6:00 to 7:00 a.m.



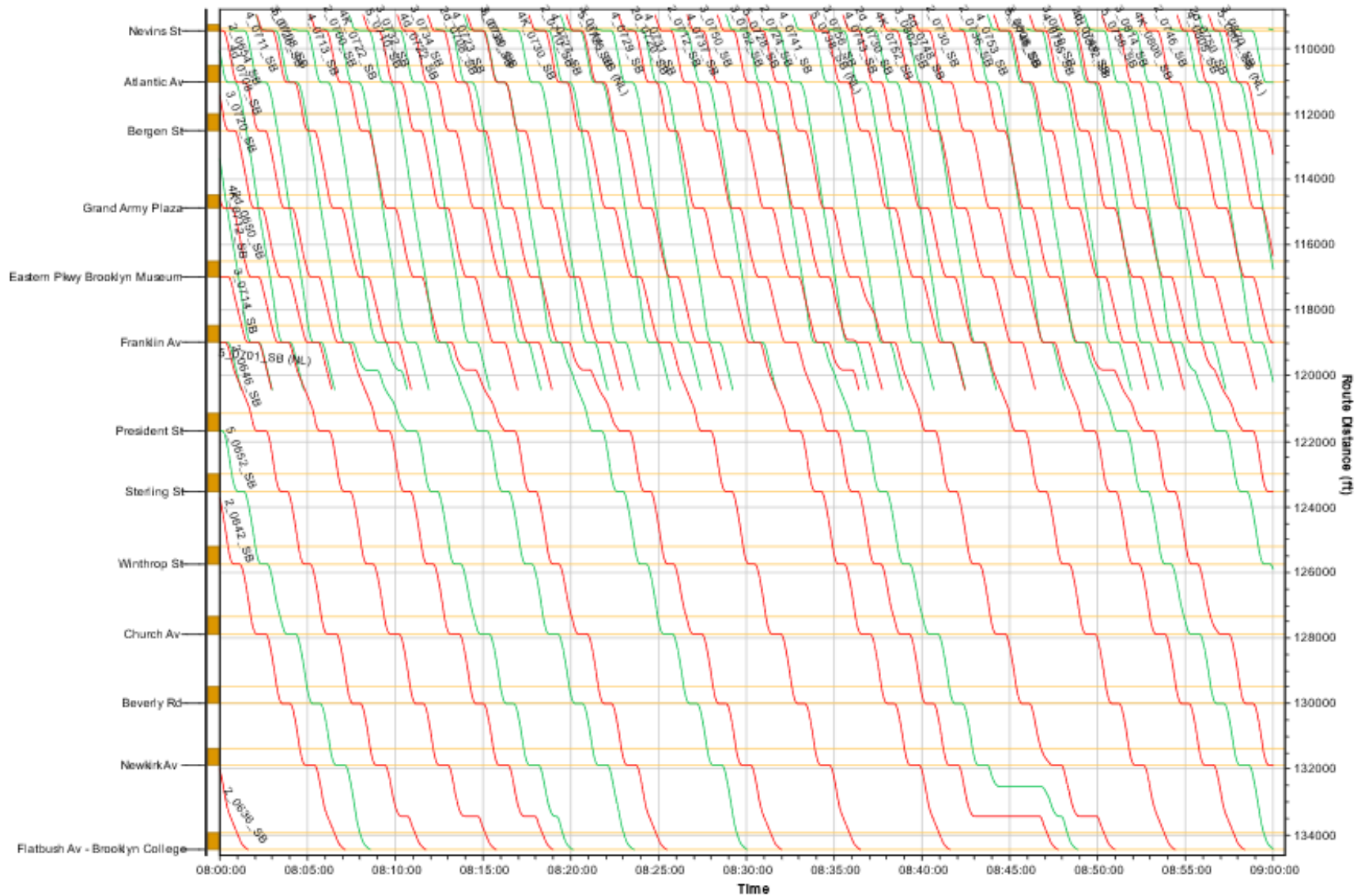
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-58: Future Baseline (CBTC) String Chart - Nevins Street to Flatbush Avenue/Brooklyn College - Southbound - 7:00 to 8:00 a.m.



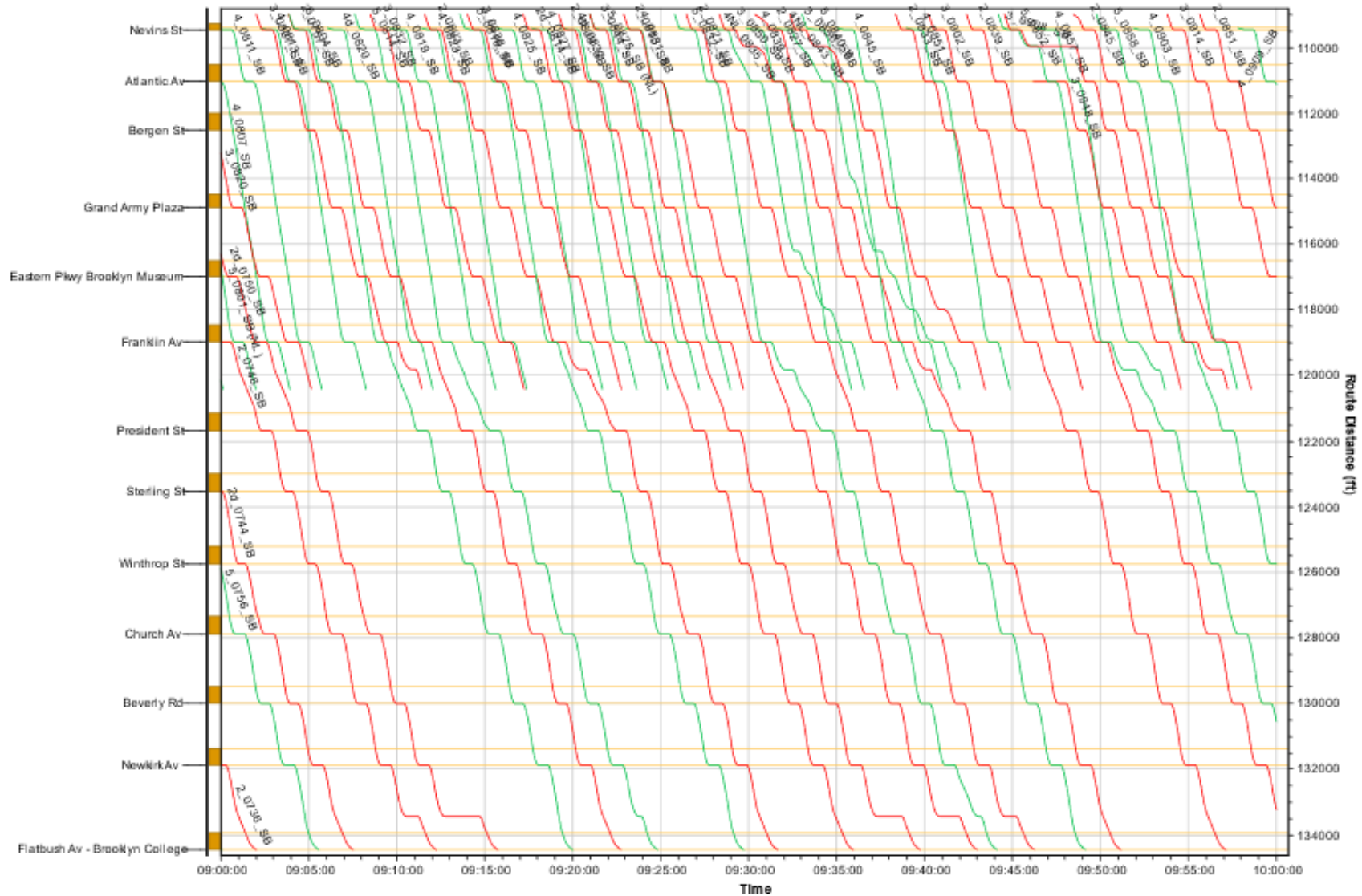
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-59: Future Baseline (CBTC) String Chart - Nevins Street to Flatbush Avenue/Brooklyn College - Southbound - 8:00 to 9:00 a.m.



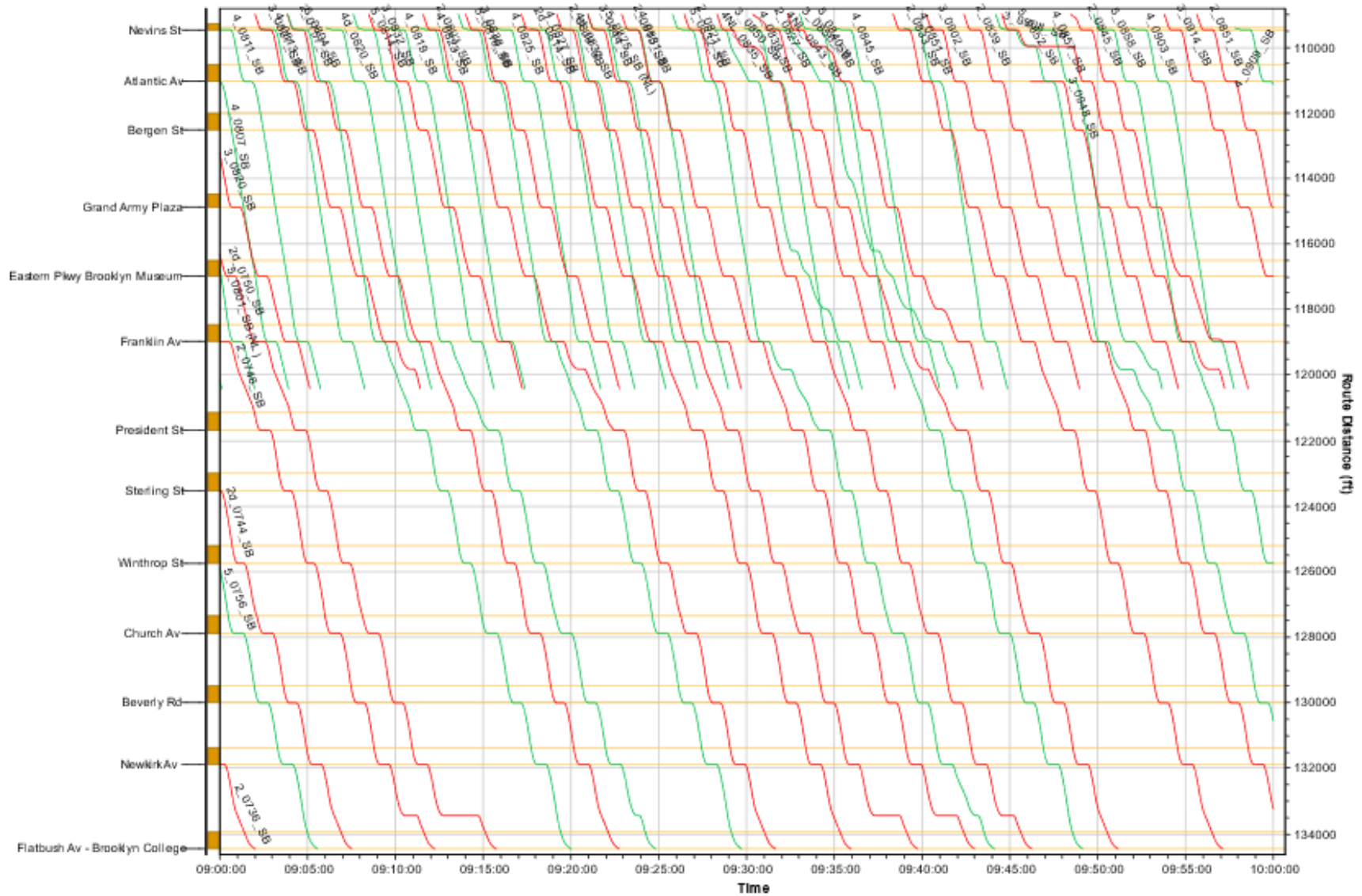
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-60: Future Baseline (CBTC) String Chart - Nevins Street to Flatbush Avenue/Brooklyn College - Southbound - 9:00 to 10:00 a.m.



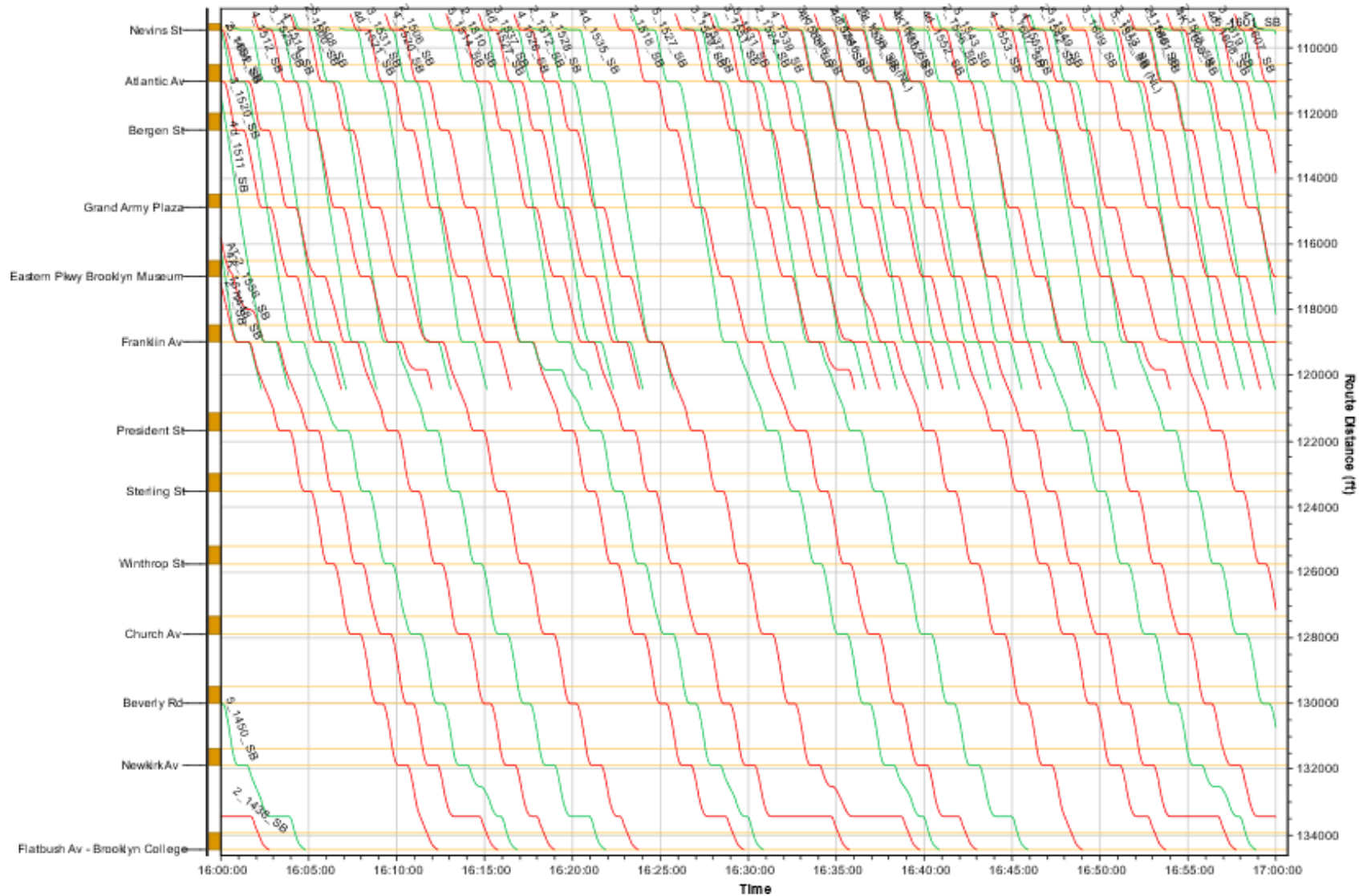
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-61: Future Baseline (CBTC) String Chart - Nevins Street to Flatbush Avenue/Brooklyn College - Southbound - 3:00 to 4:00 p.m.



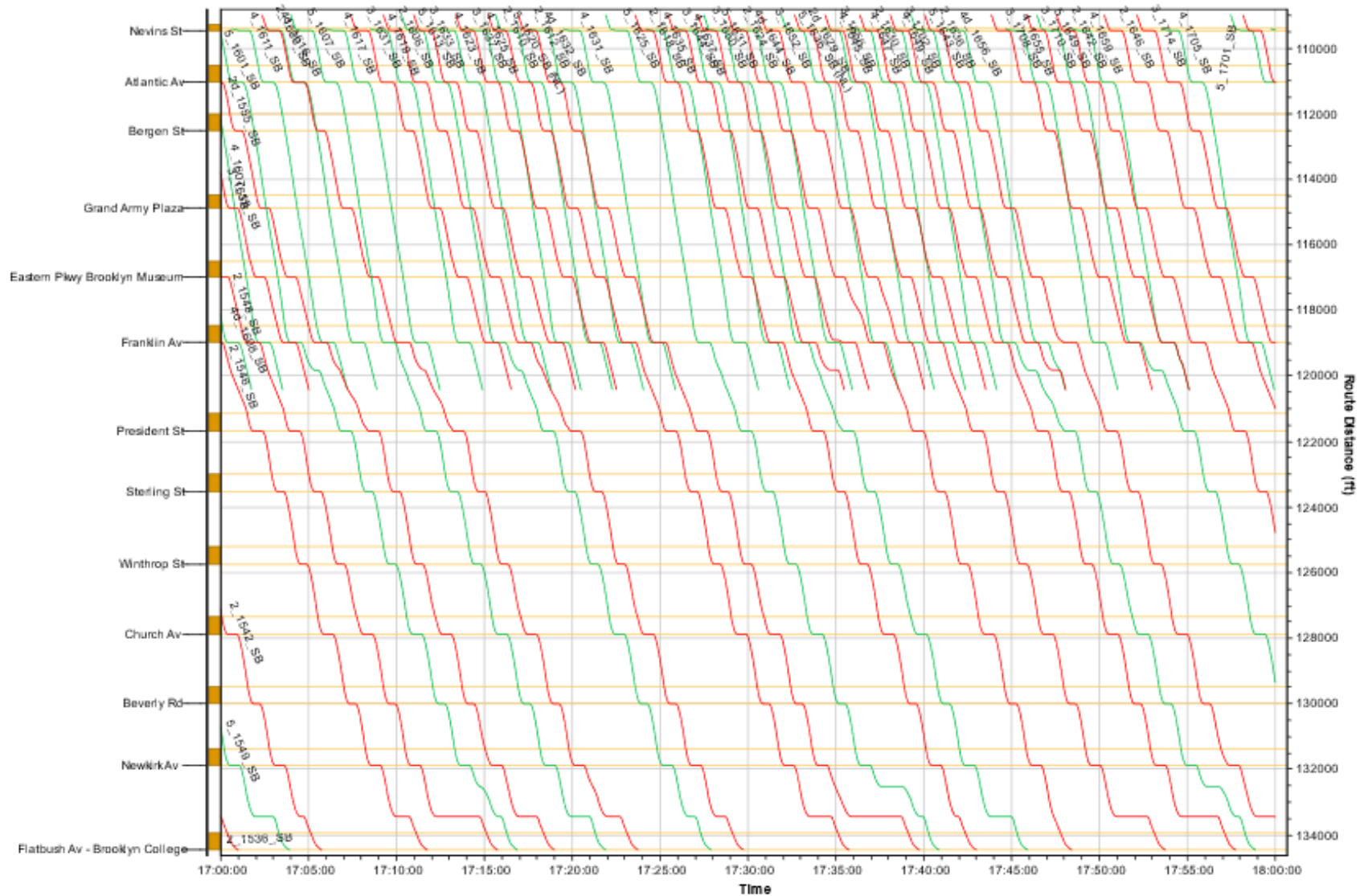
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-62: Future Baseline (CBTC) String Chart - Nev Nevins Street to Flatbush Avenue/Brooklyn College - Southbound - 4:00 to 5:00 p.m.



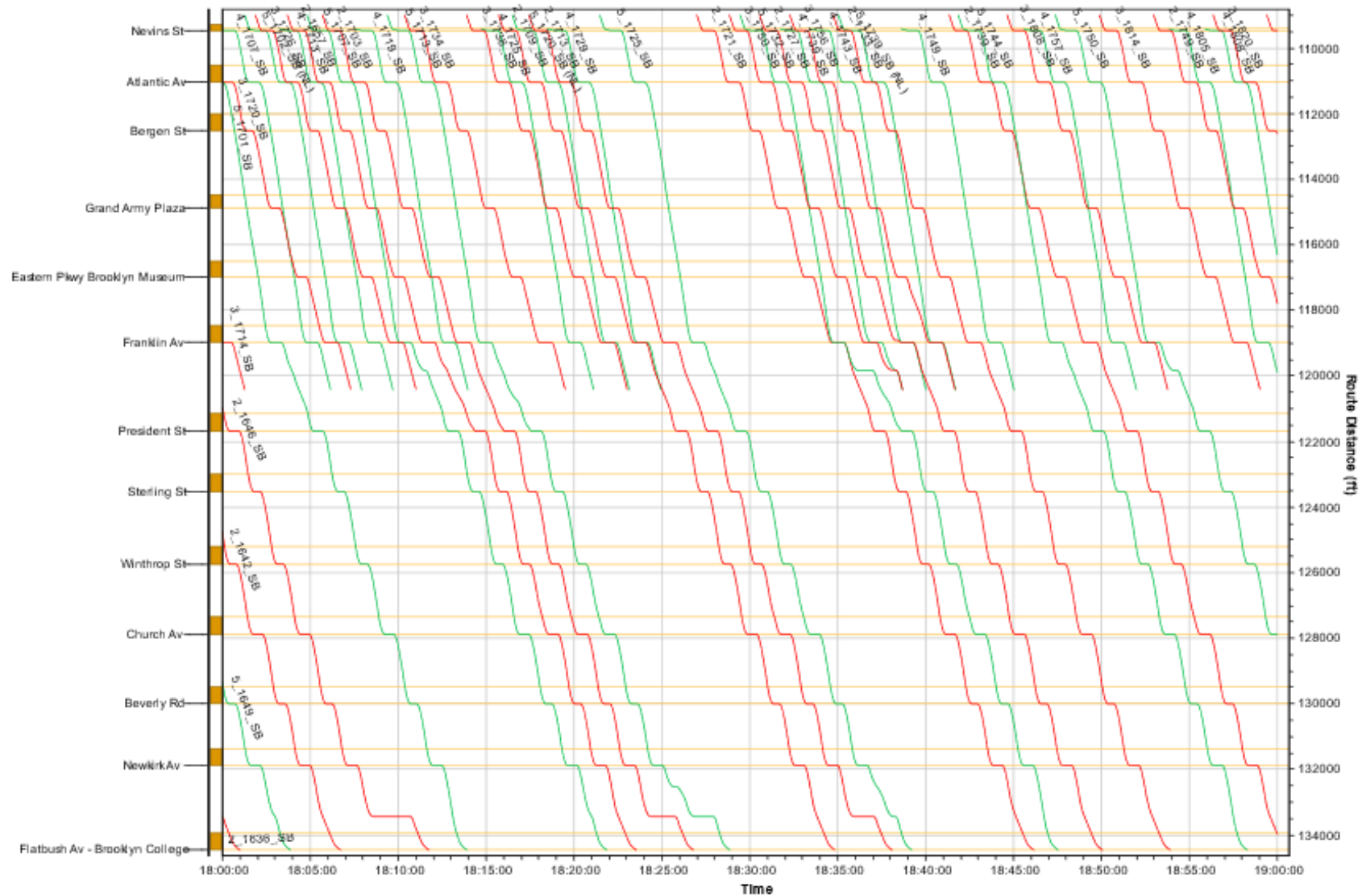
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-63: Future Baseline (CBTC) String Chart - Nevins Street to Flatbush Avenue/Brooklyn College - Southbound - 5:00 to 6:00 p.m.



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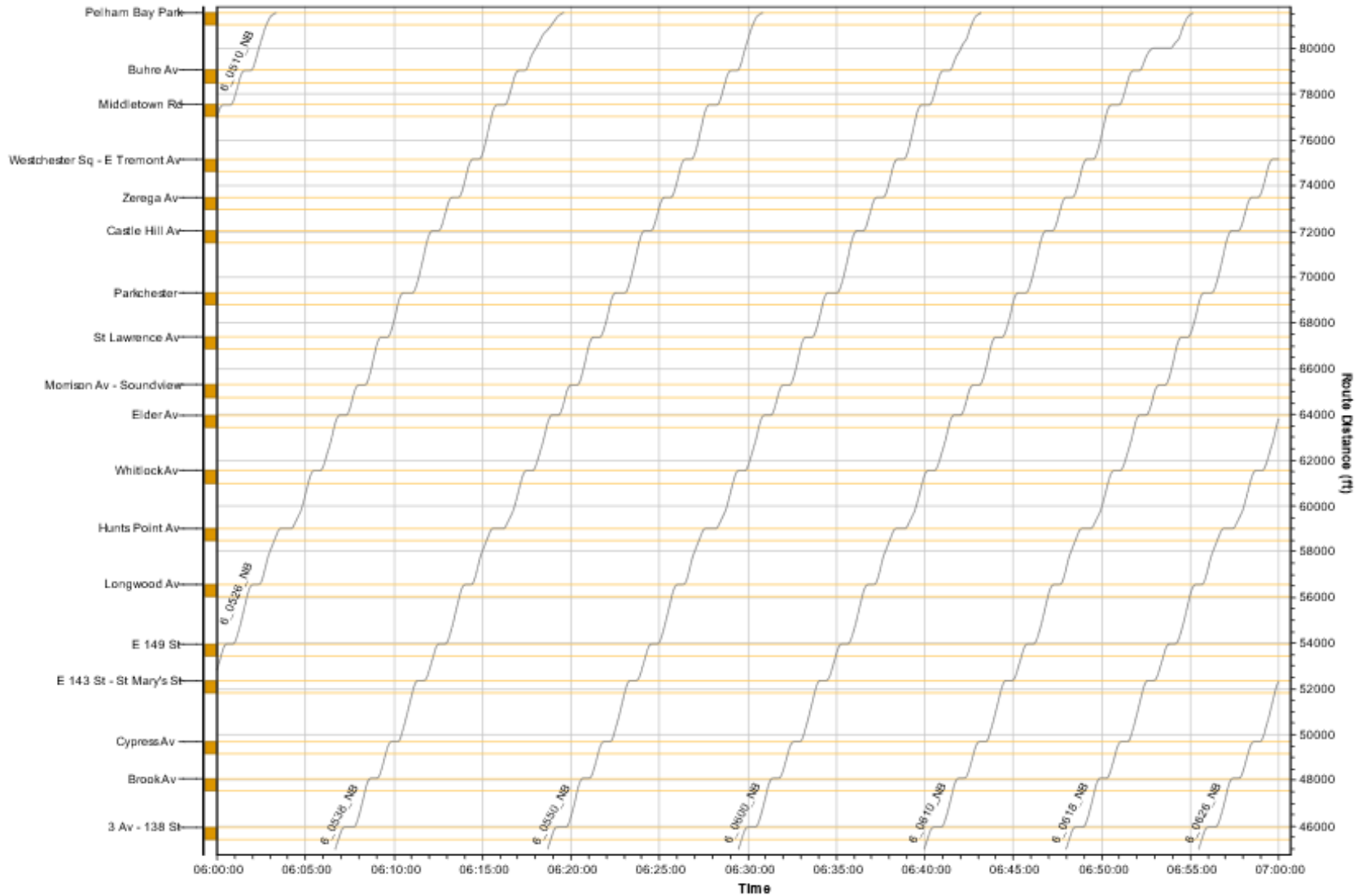
Figure G.4-64: Future Baseline (CBTC) String Chart - Nevins Street to Flatbush Avenue/Brooklyn College - Southbound - 6:00 to 7:00 p.m.



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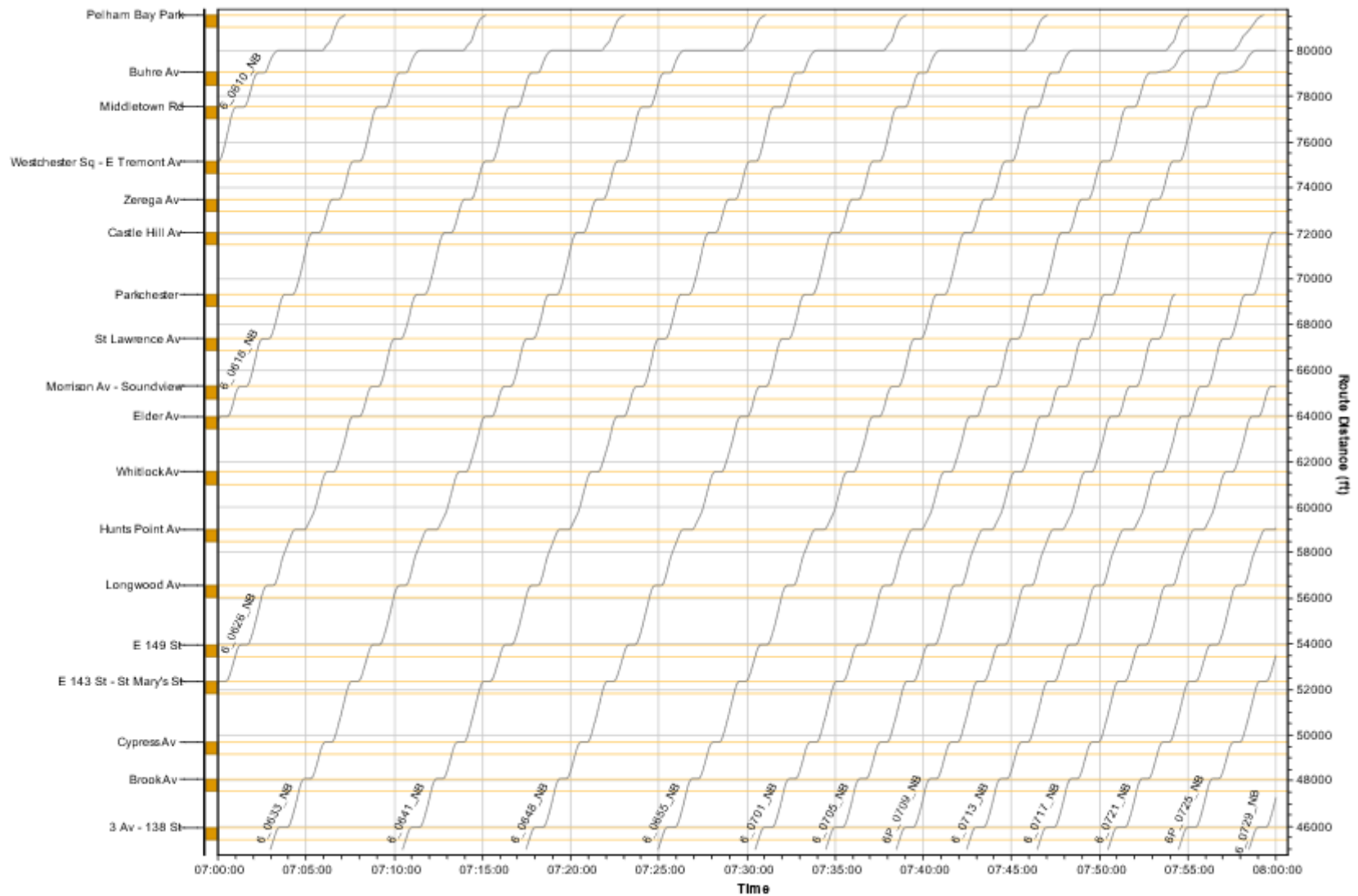
G.4.5 Pelham Bay Park to 3 Avenue-138 Street

Figure G.4-65: Future Baseline (CBTC) String Chart – 3 Avenue-138 Street to Pelham Bay Park – Northbound – 6:00 to 7:00 a.m.



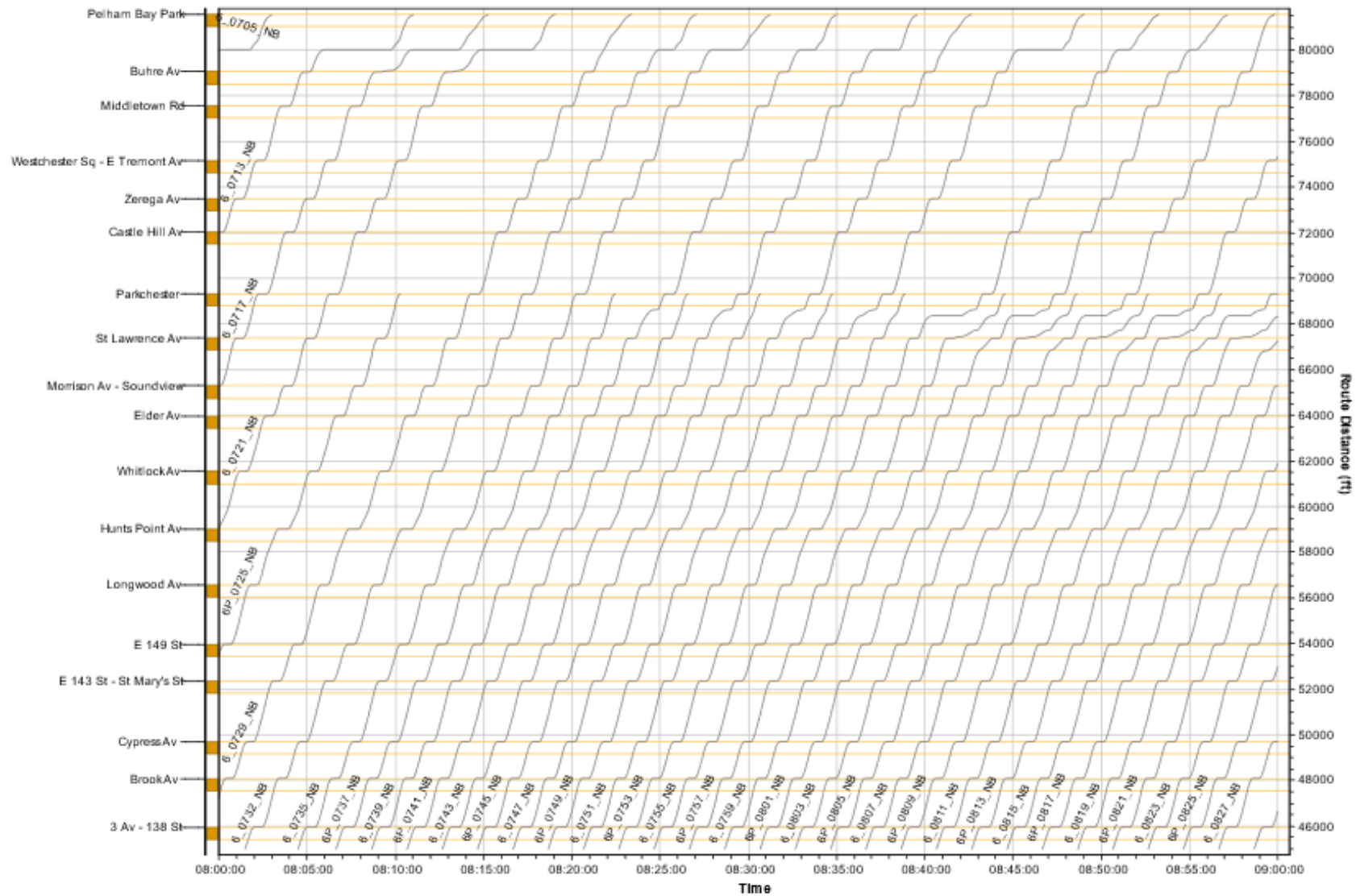
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-66: Future Baseline (CBTC) String Chart – 3 Avenue-138 Street to Pelham Bay Park – Northbound – 7:00 to 8:00 a.m.



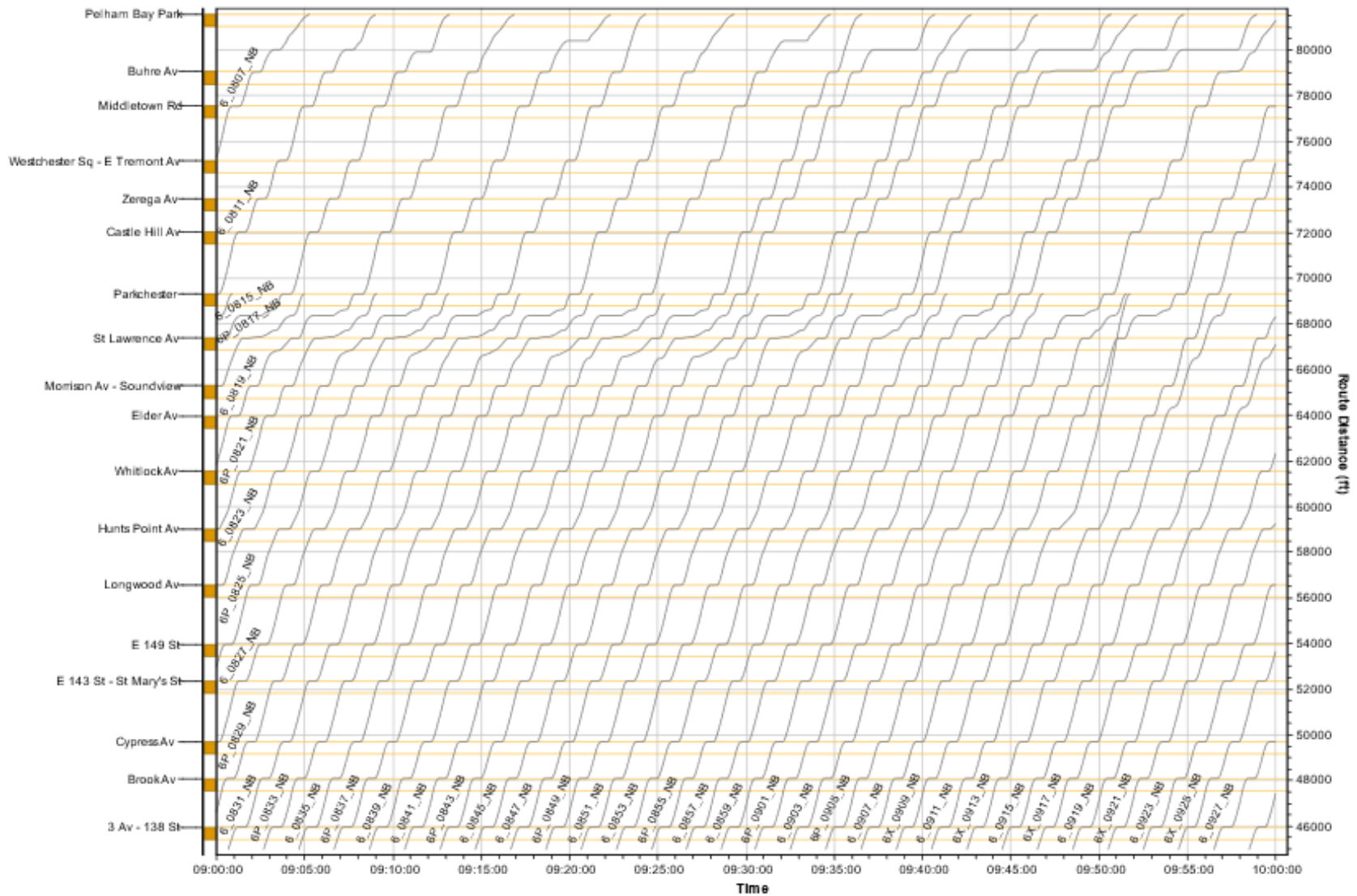
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-67: Future Baseline (CBTC) String Chart – 3 Avenue-138 Street to Pelham Bay Park – Northbound – 8:00 to 9:00 a.m.



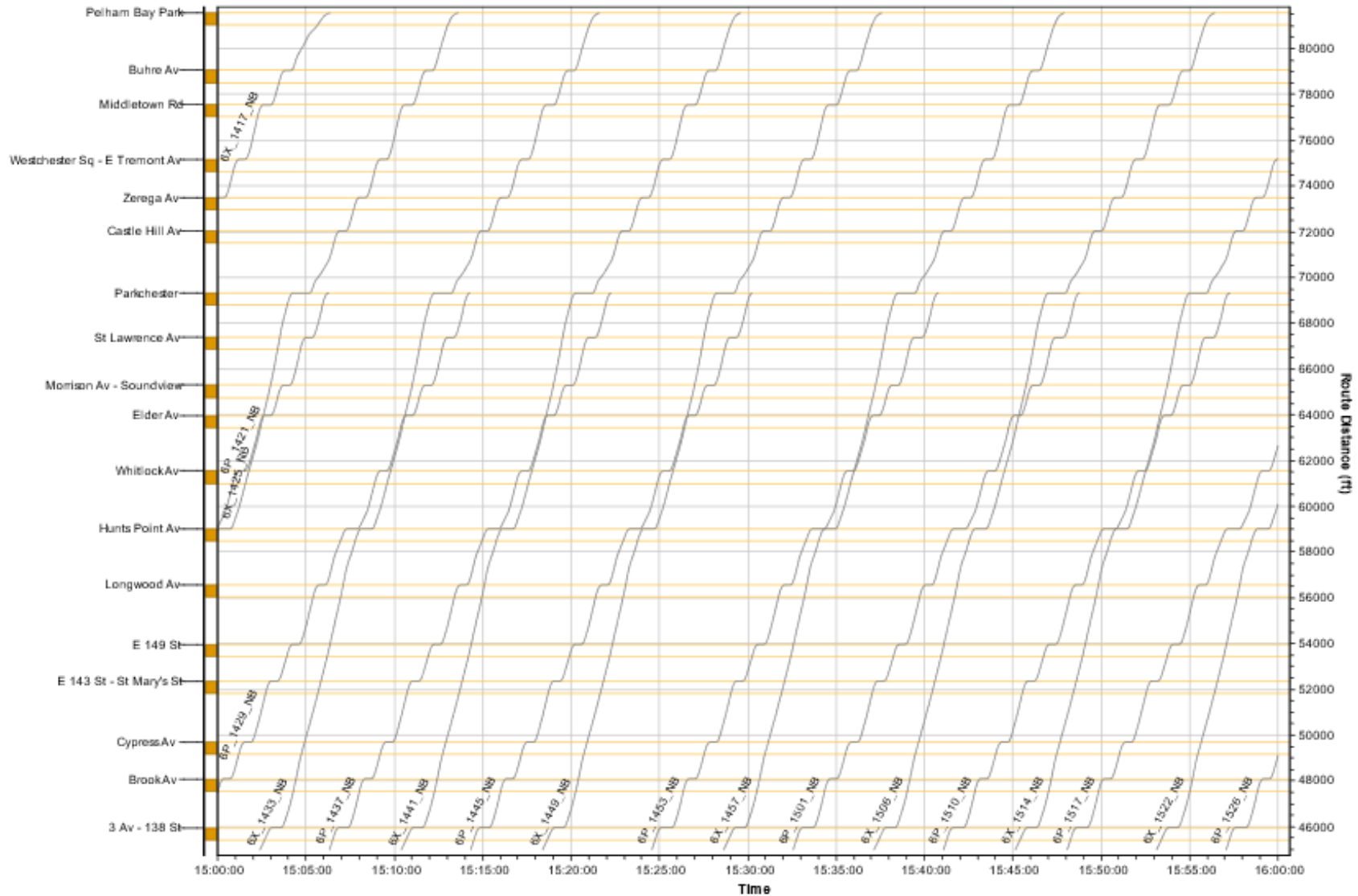
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-68: Future Baseline (CBTC) String Chart – 3 Avenue-138 Street to Pelham Bay Park – Northbound – 9:00 to 10:00 a.m.



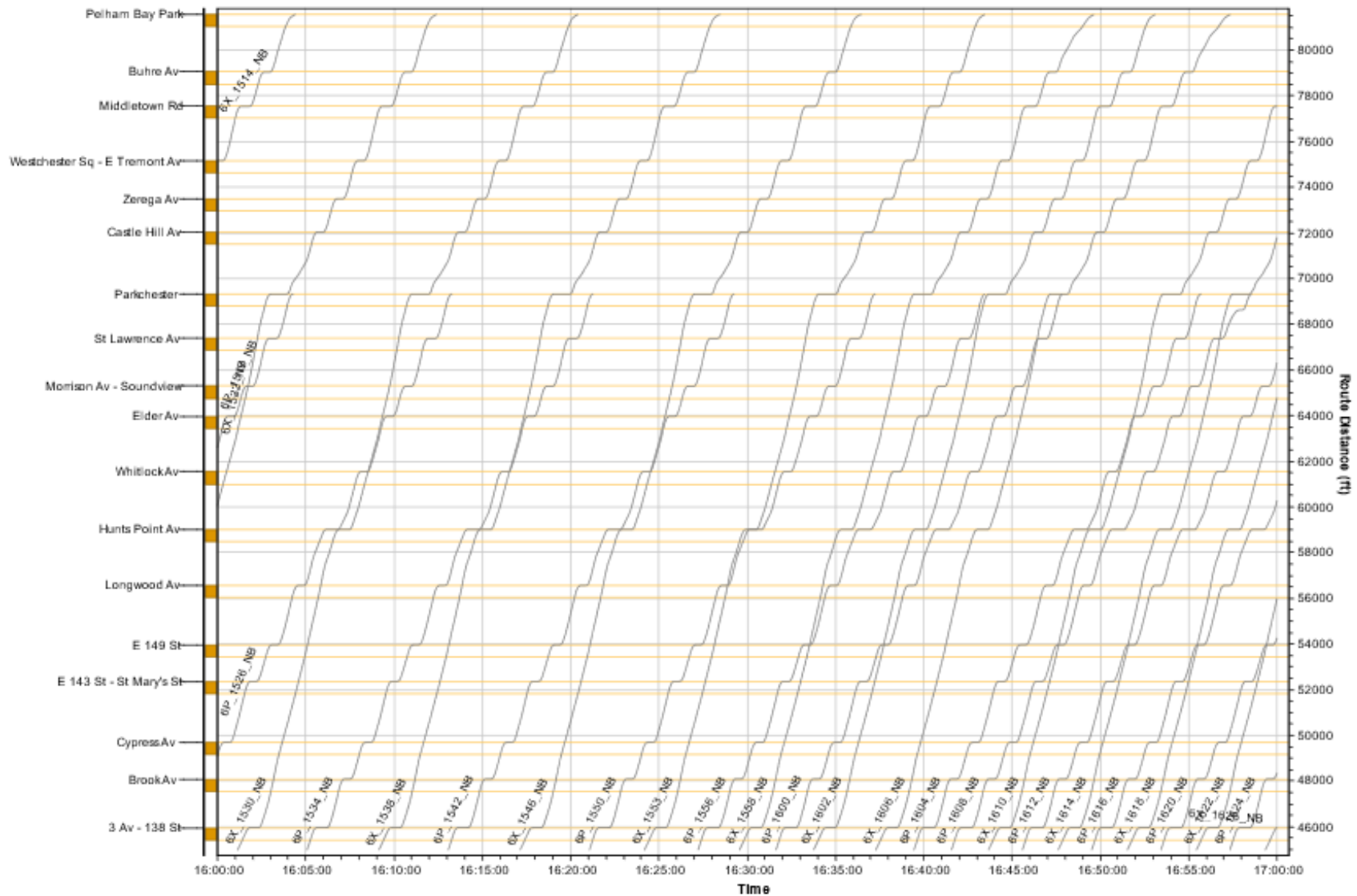
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-69: Future Baseline (CBTC) String Chart – 3 Avenue-138 Street to Pelham Bay Park – Northbound – 3:00 to 4:00 p.m.



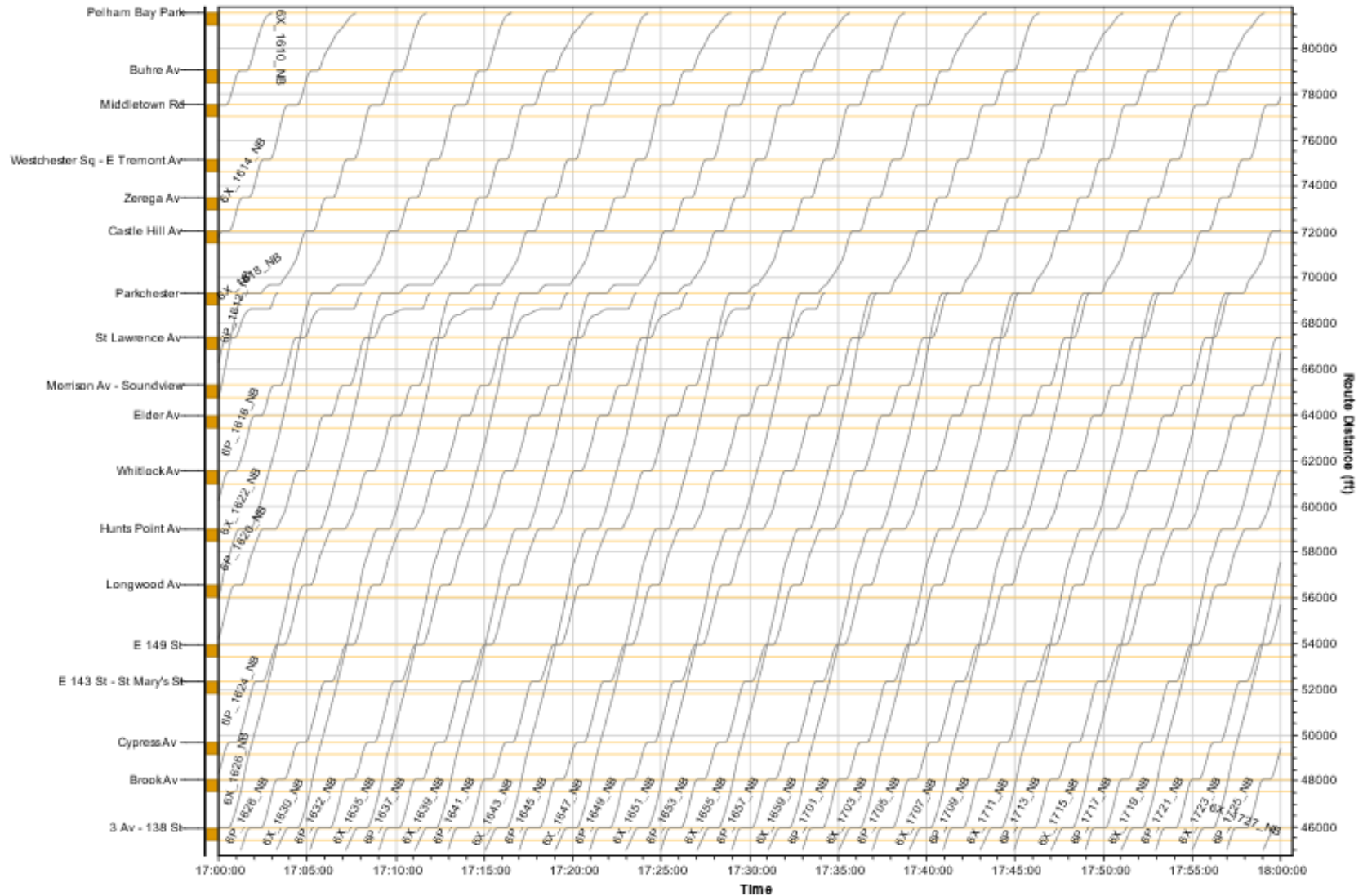
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-70: Future Baseline (CBTC) String Chart – 3 Avenue-138 Street to Pelham Bay Park – Northbound – 4:00 to 5:00 p.m.



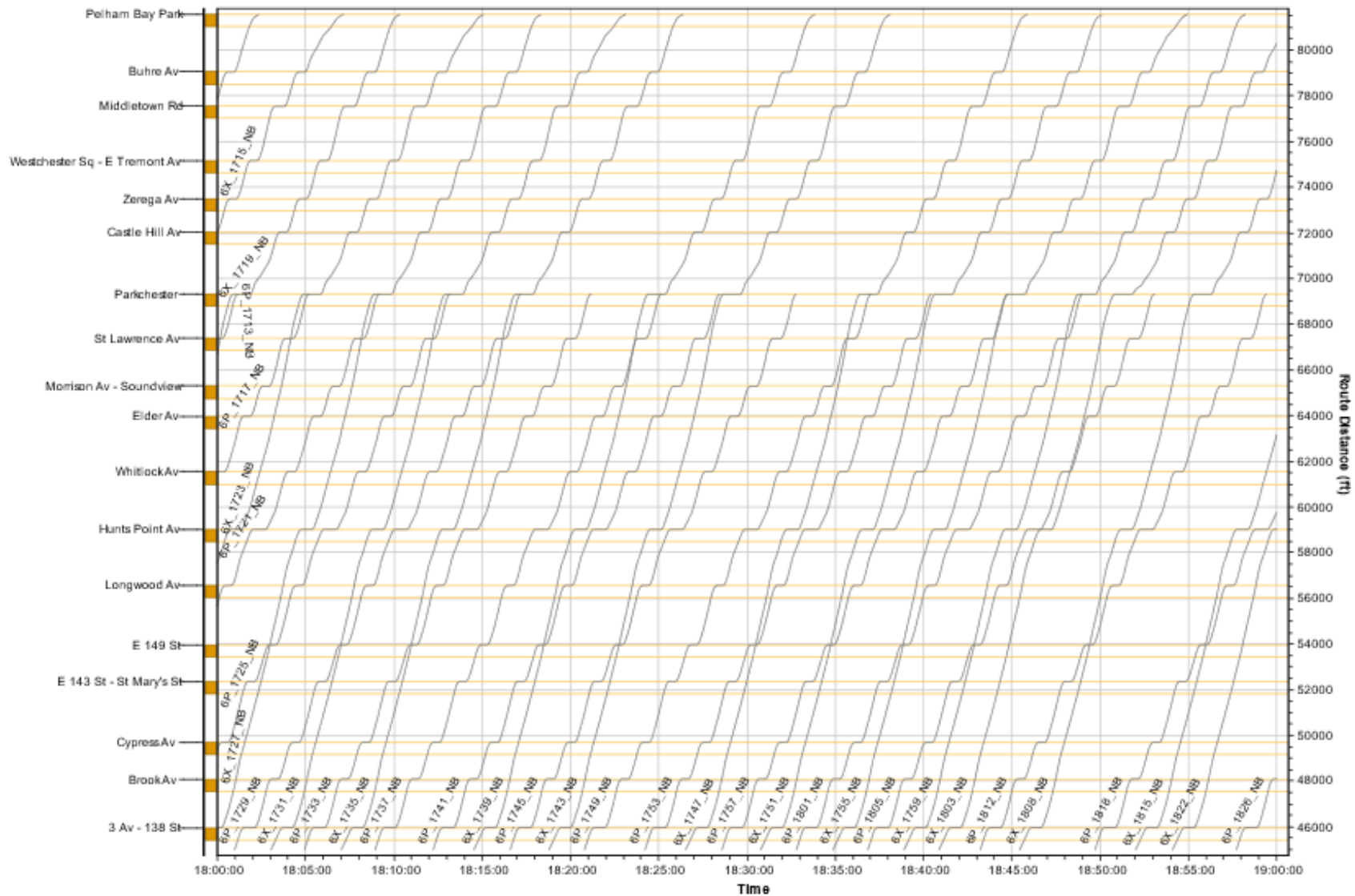
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-71: Future Baseline (CBTC) String Chart – 3 Avenue-138 Street to Pelham Bay Park – Northbound – 5:00 to 6:00 p.m.



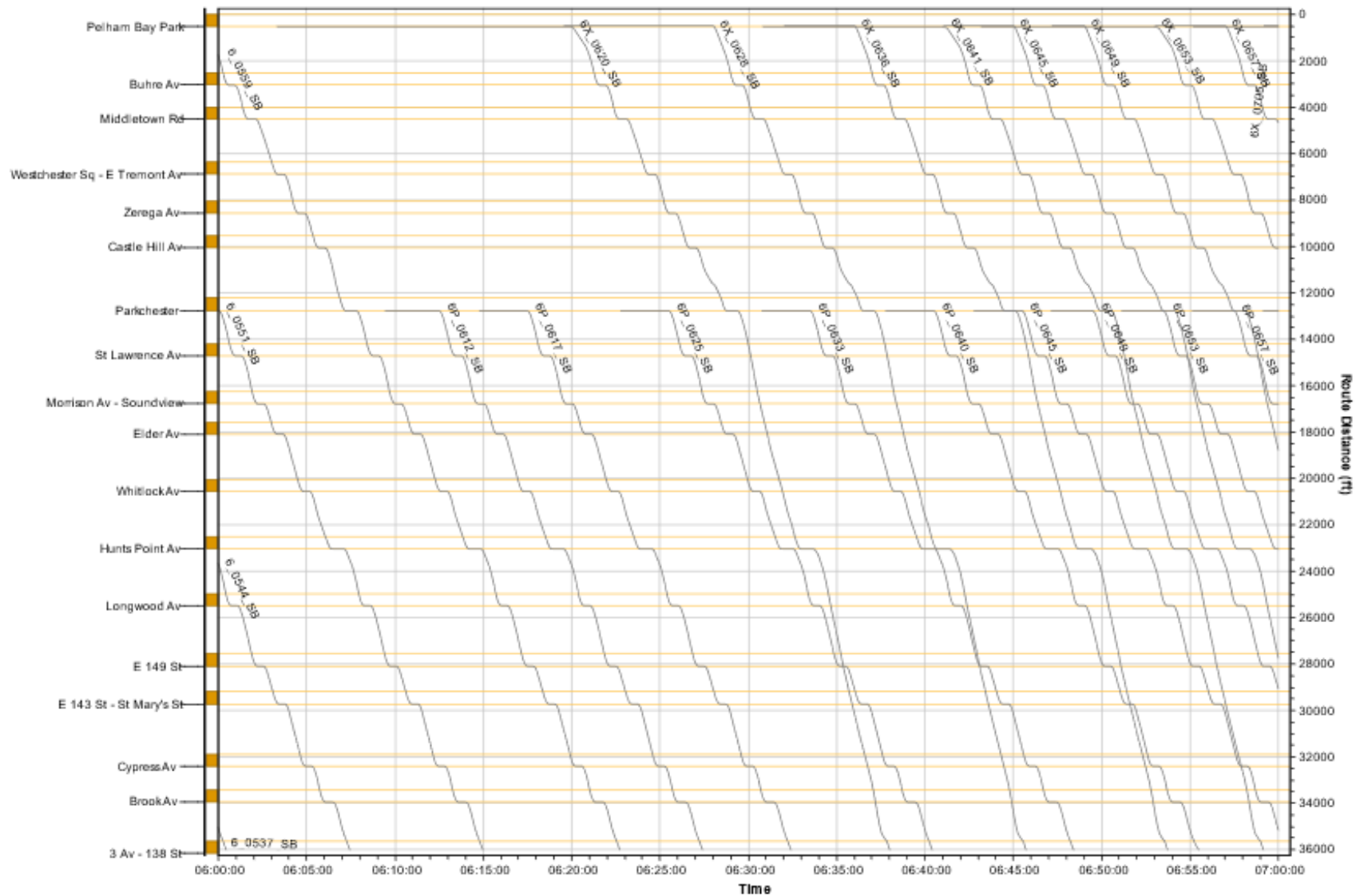
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-72: Future Baseline (CBTC) String Chart– 3 Avenue-138 Street to Pelham Bay Park – Northbound – 6:00 to 7:00 p.m.



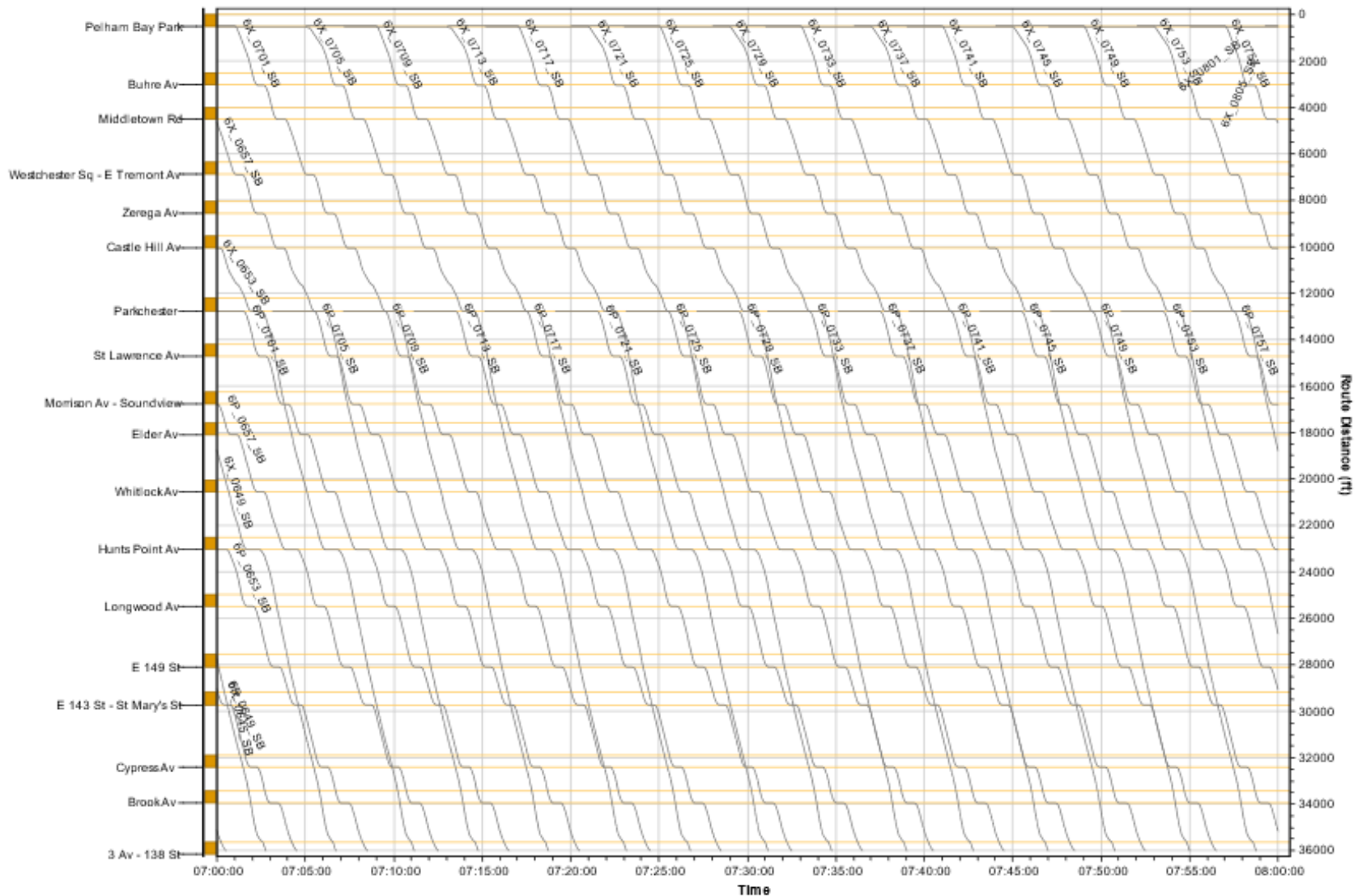
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-73: Future Baseline (CBTC) String Chart – Pelham Bay Park to 3 Avenue-138 Street – Southbound – 6:00 to 7:00 a.m.



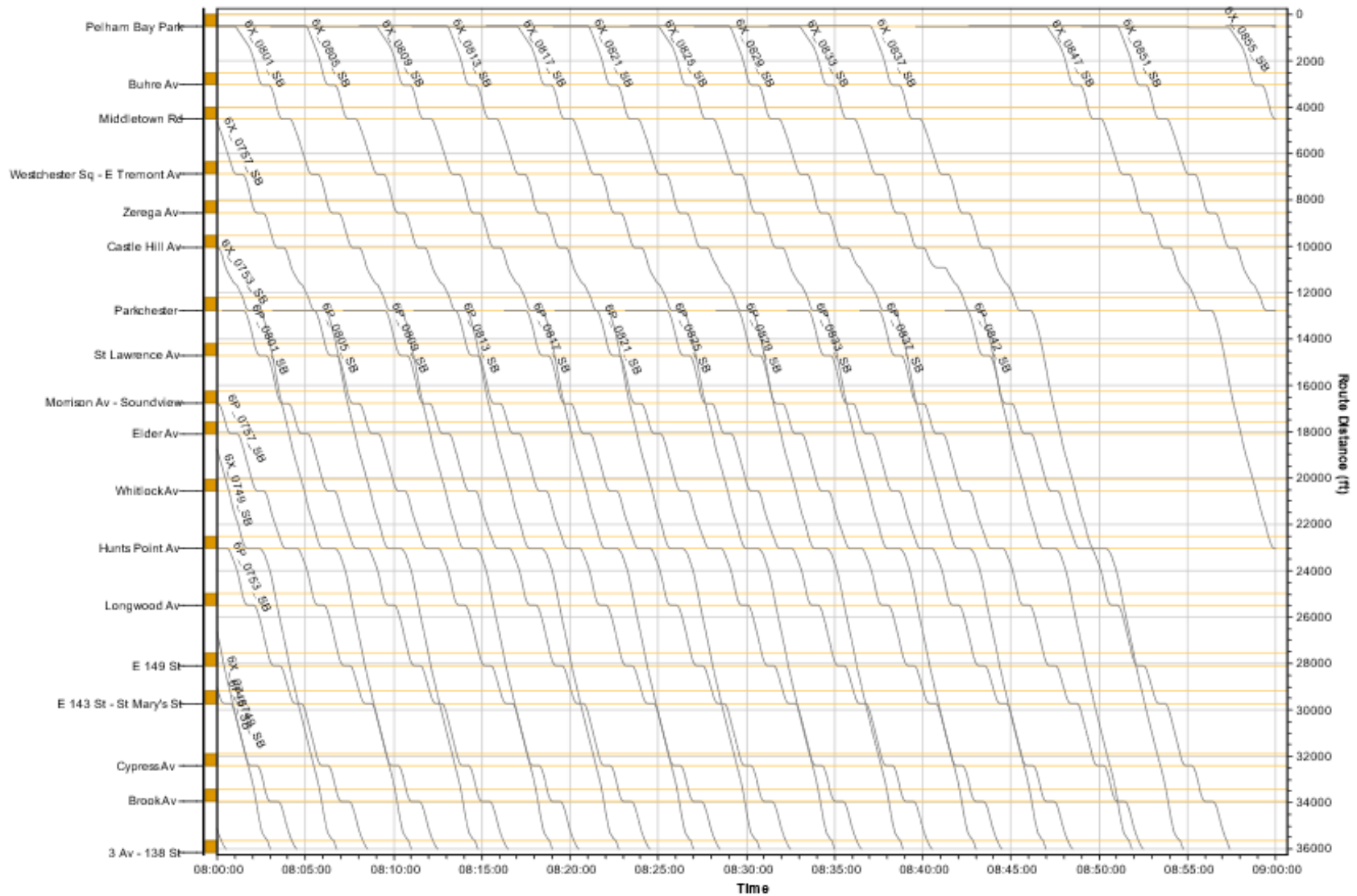
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-74: Future Baseline (CBTC) String Chart – Pelham Bay Park to 3 Avenue-138 Street – Southbound – 7:00 to 8:00 a.m.



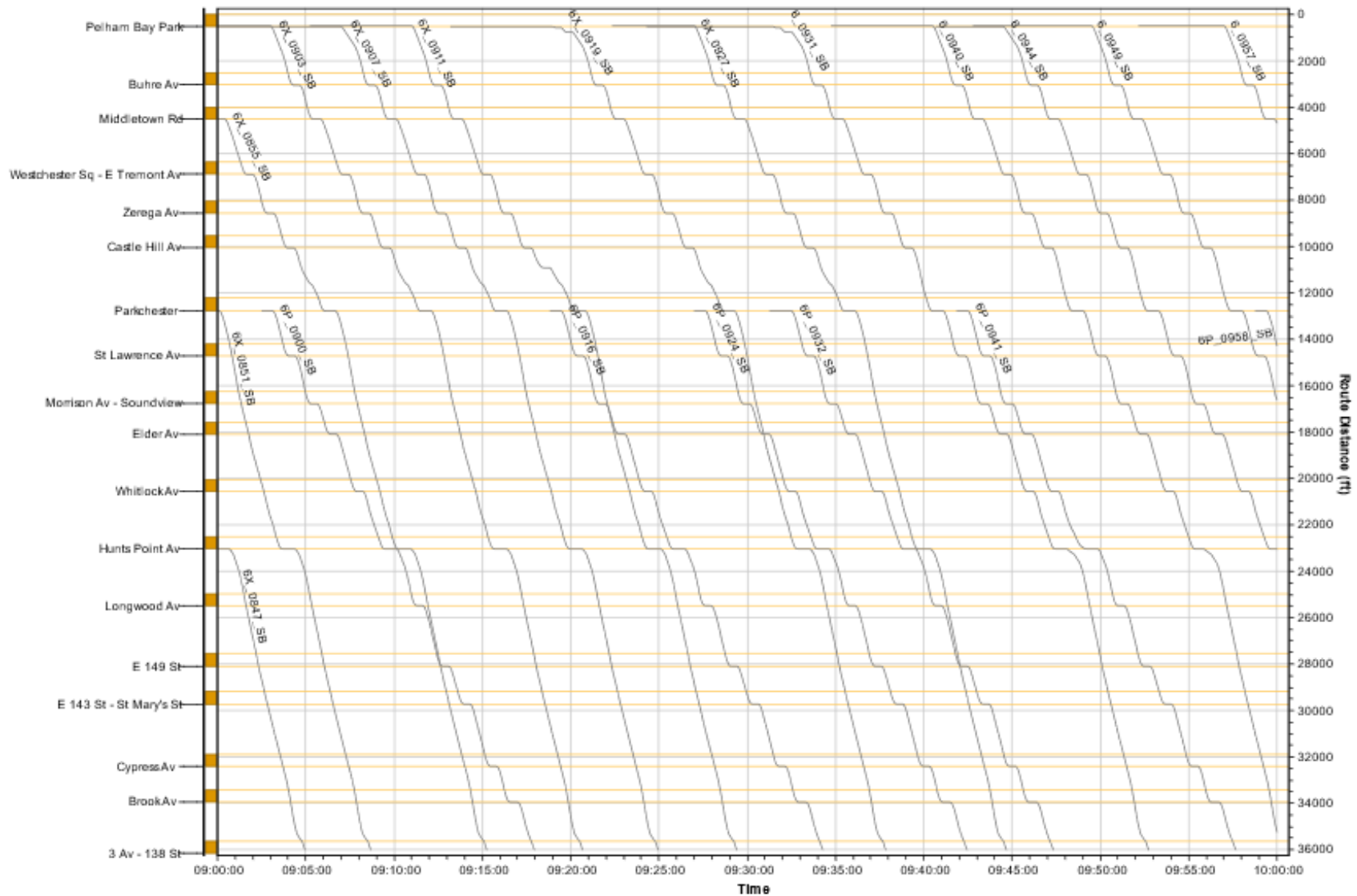
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-75: Future Baseline (CBTC) String Chart – Pelham Bay Park to 3 Avenue-138 Street – Southbound – 8:00 to 9:00 a.m.



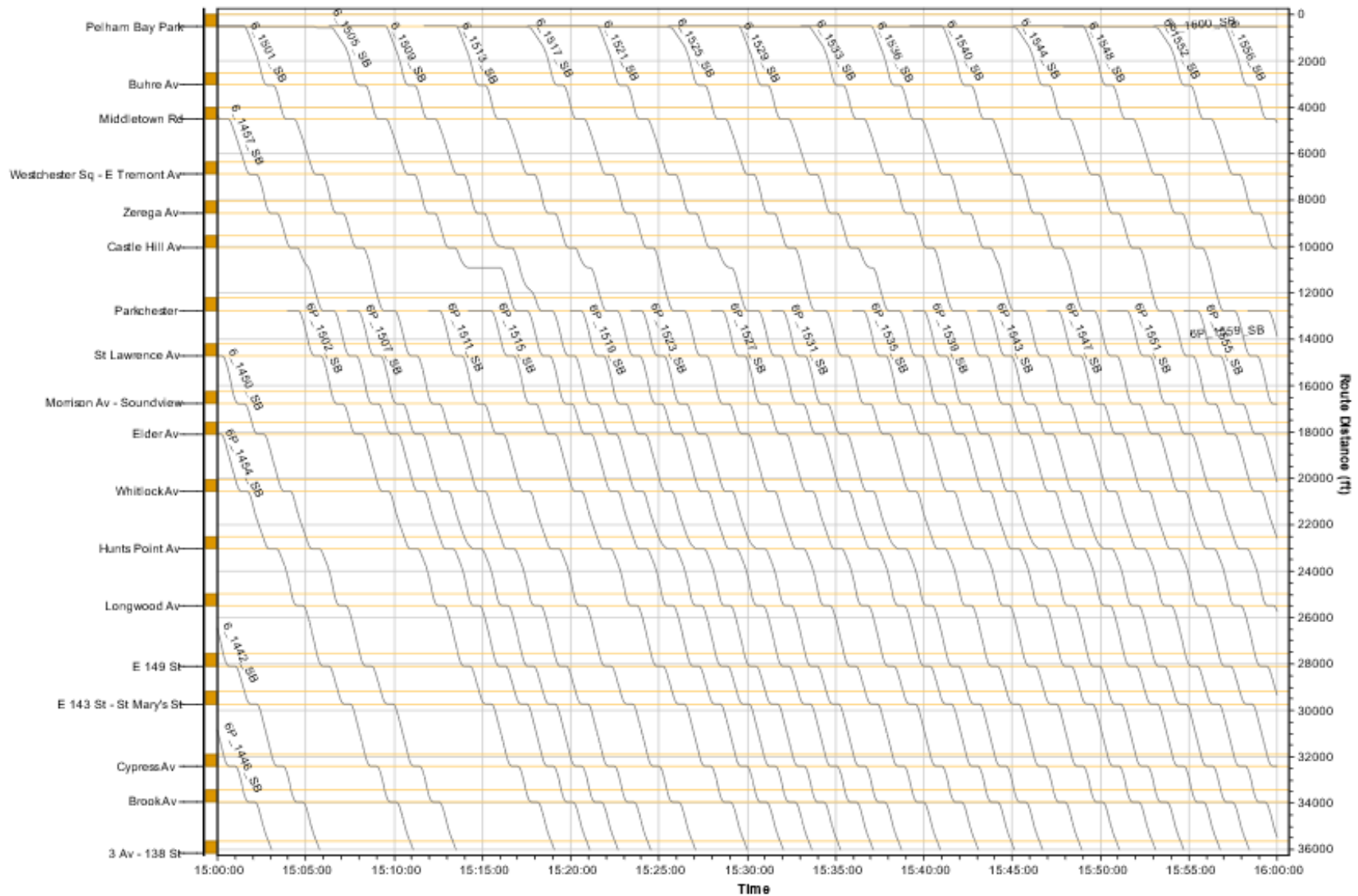
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-76: Future Baseline (CBTC) String Chart – Pelham Bay Park to 3 Avenue-138 Street – Southbound – 9:00 to 10:00 a.m.



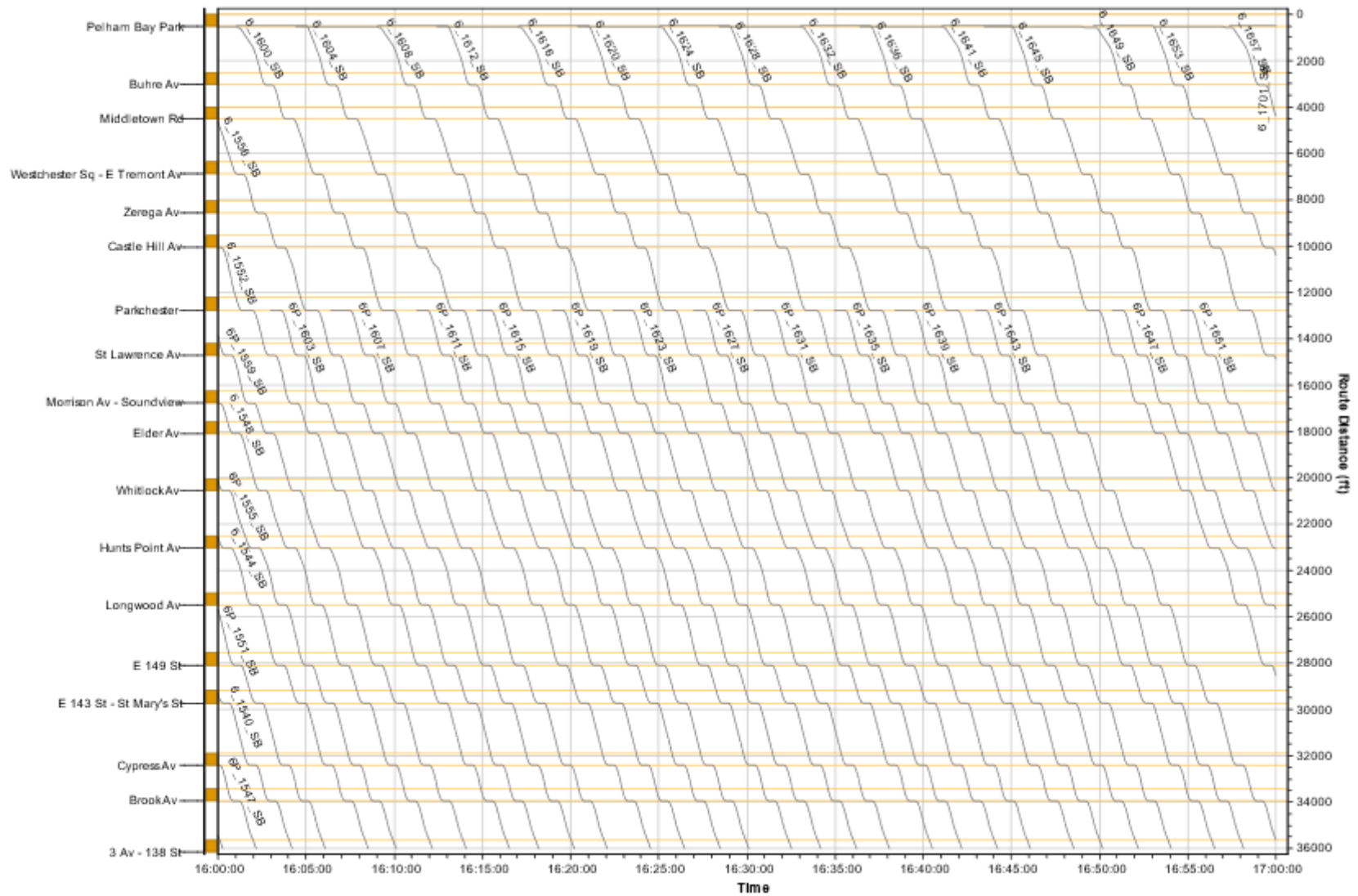
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-77: Future Baseline (CBTC) String Chart – Pelham Bay Park to 3 Avenue-138 Street – Southbound – 3:00 to 4:00 p.m.



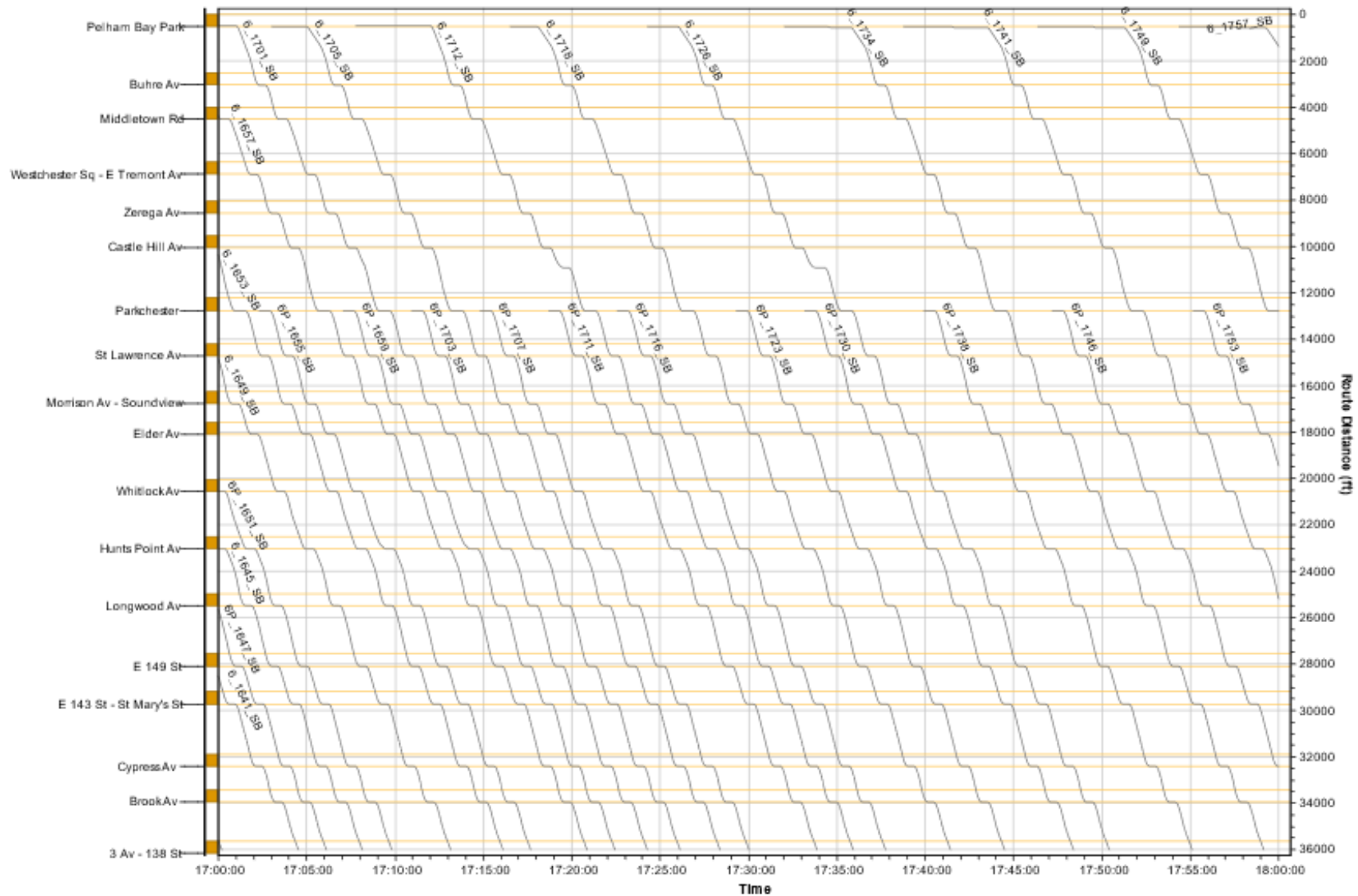
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-78: Future Baseline (CBTC) String Chart – Pelham Bay Park to 3 Avenue-138 Street – Southbound – 4:00 to 5:00 p.m.



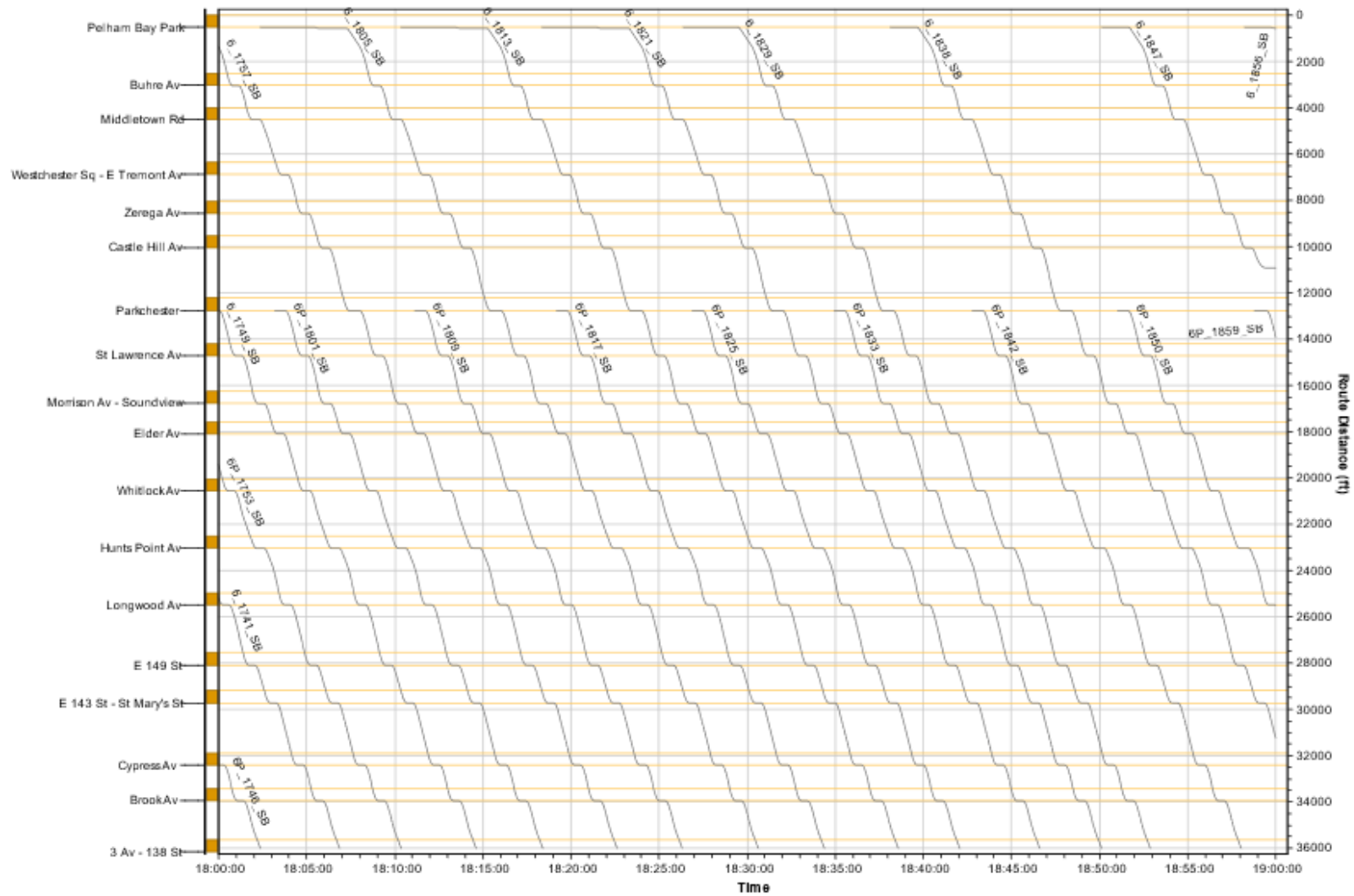
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-79: Future Baseline (CBTC) String Chart – Pelham Bay Park to 3 Avenue-138 Street – Southbound – 5:00 to 6:00 p.m.



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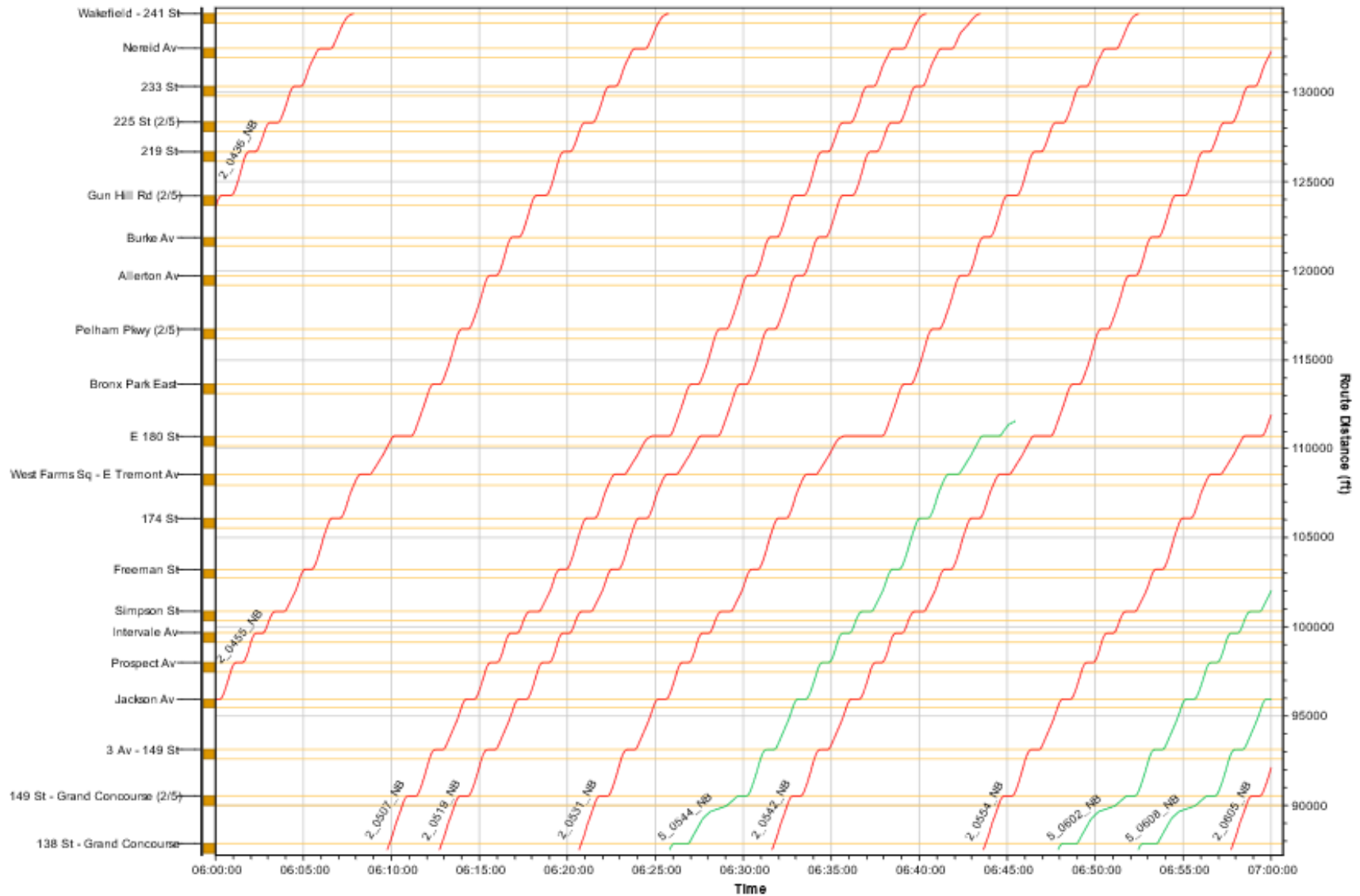
Figure G.4-80: Future Baseline (CBTC) String Chart – Pelham Bay Park to 3 Avenue-138 Street – Southbound – 6:00 to 7:00 p.m.



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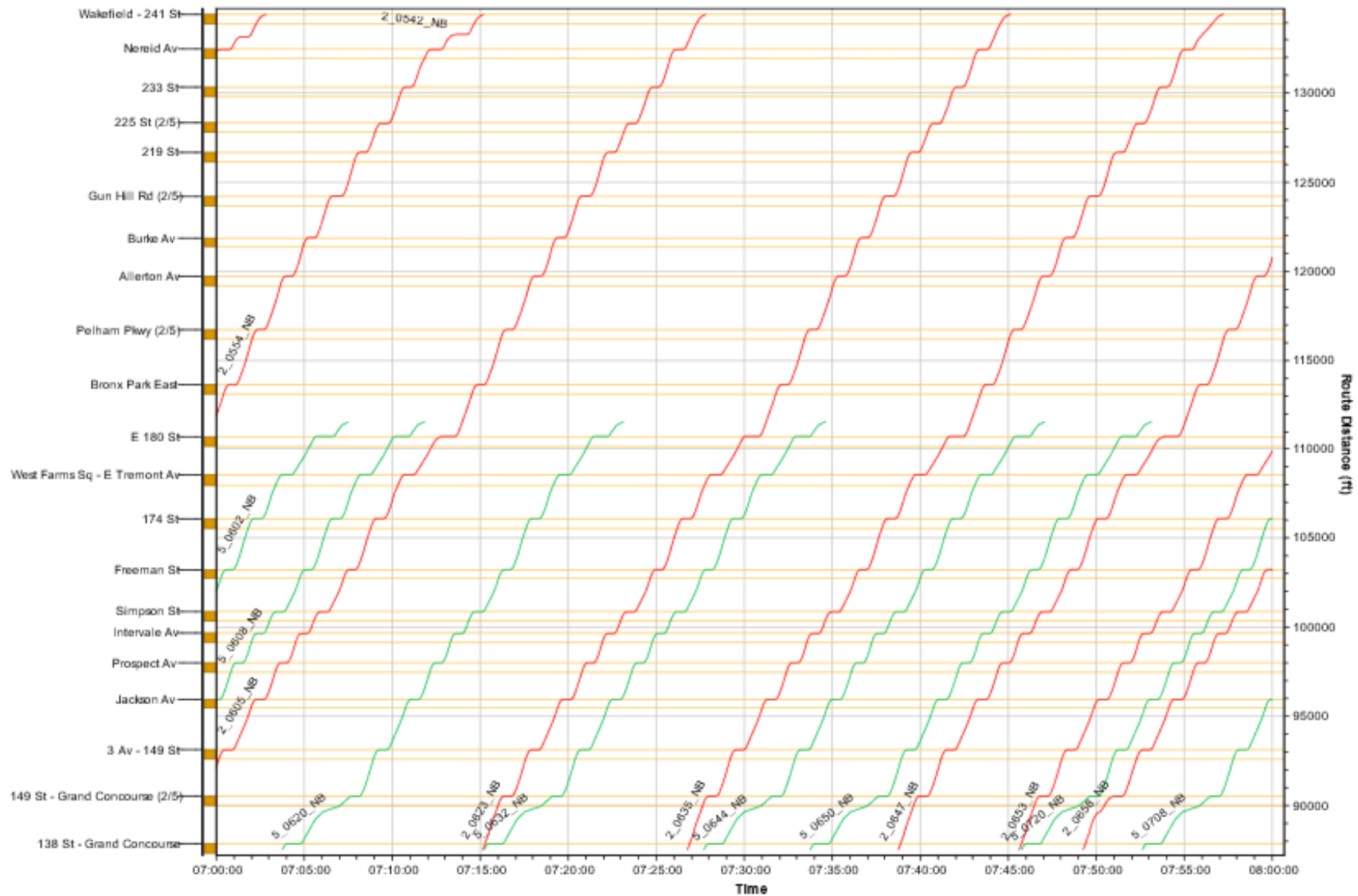
G.4.6 Wakefield-241 Street to 138 Street-Grand Concourse

Figure G.4-81: Future Baseline (CBTC) String Chart – 138 Street-Grand Concourse to Wakefield-241 Street– Northbound – 6:00 to 7:00 a.m.



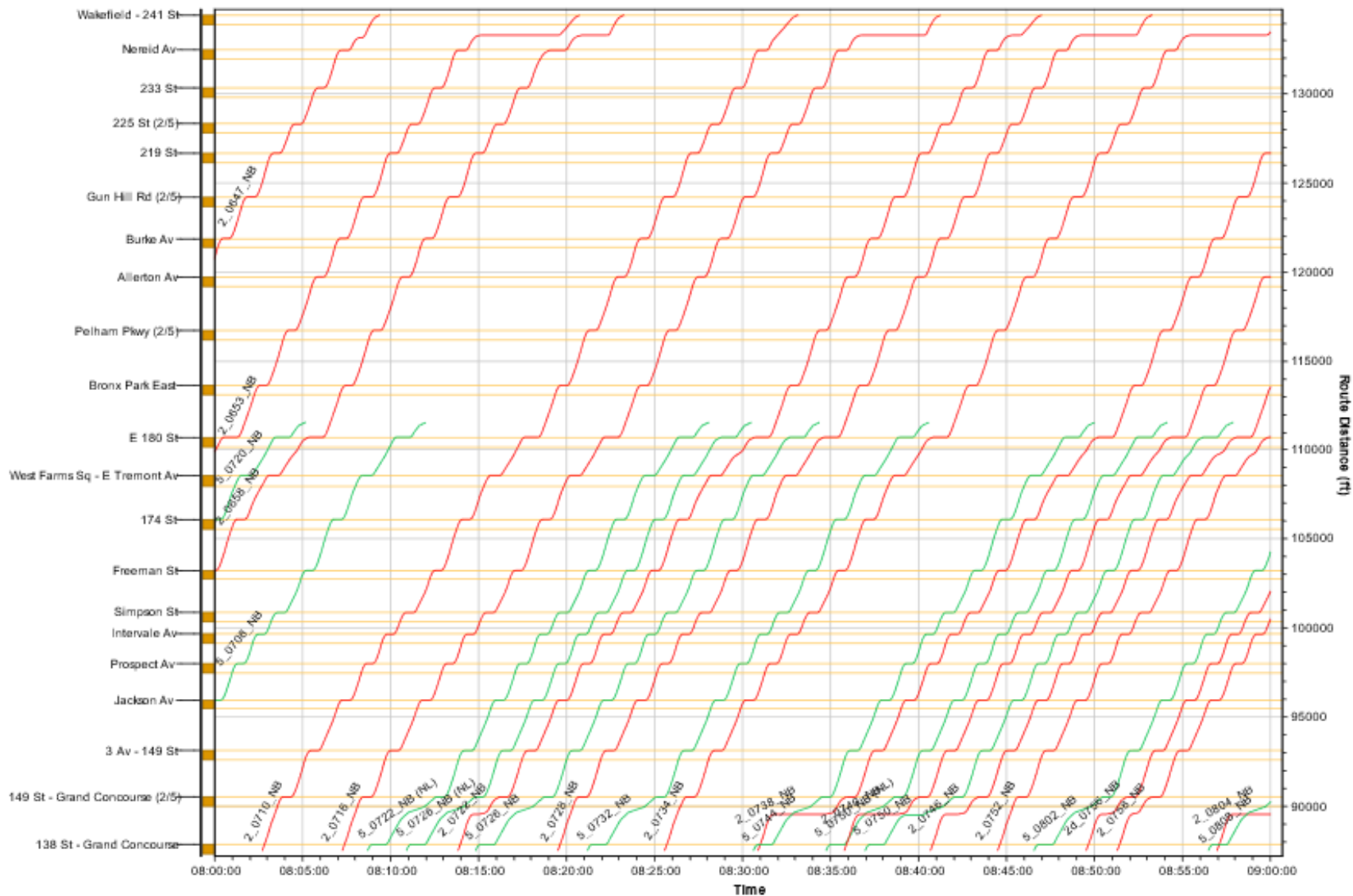
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-82: Future Baseline (CBTC) String Chart – 138 Street-Grand Concourse to Wakefield-241 Street – Northbound – 7:00 to 8:00 a.m.



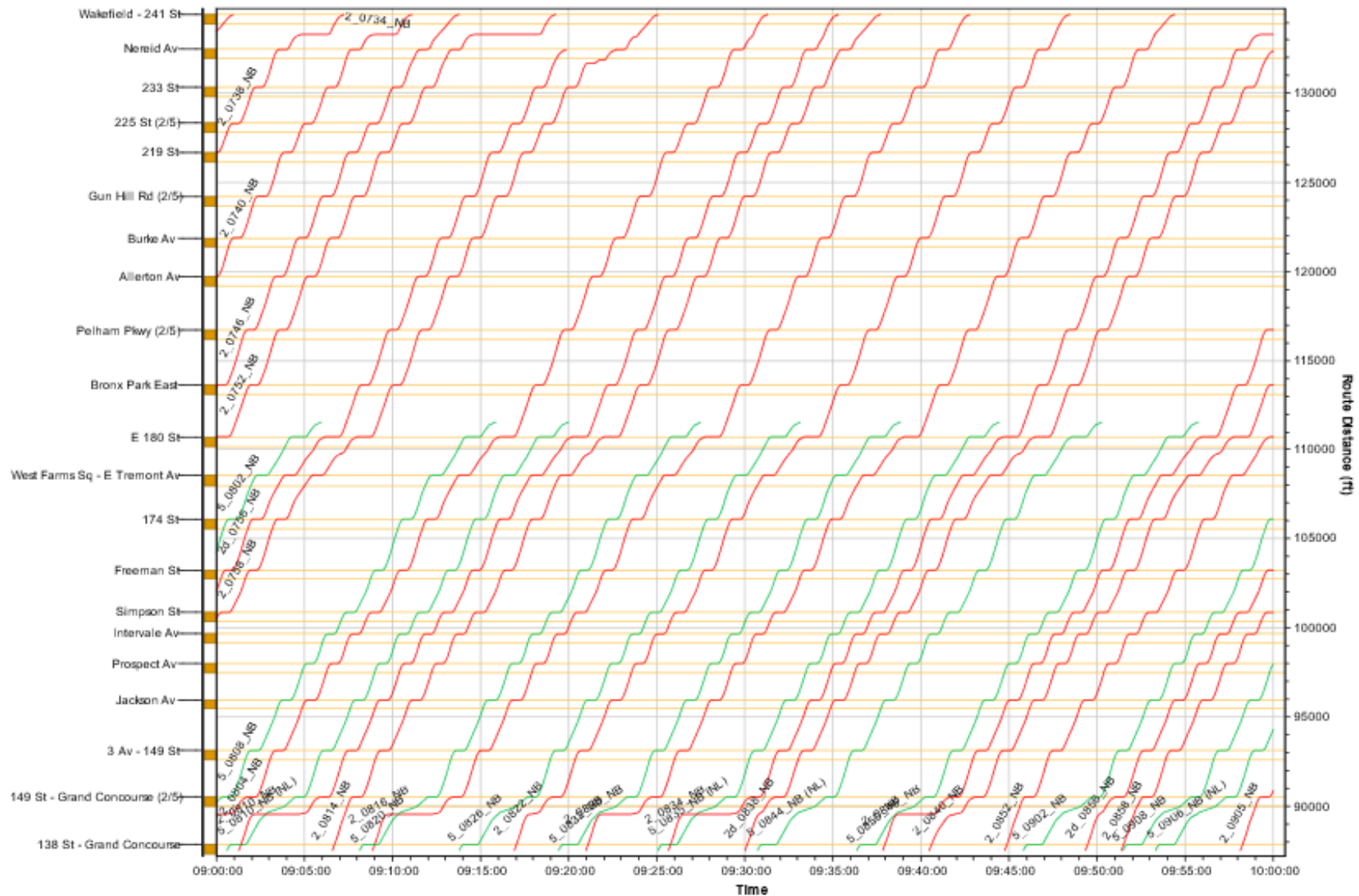
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-83: Future Baseline (CBTC) String Chart – 138 Street-Grand Concourse to Wakefield-241 Street – Northbound – 8:00 to 9:00 a.m.



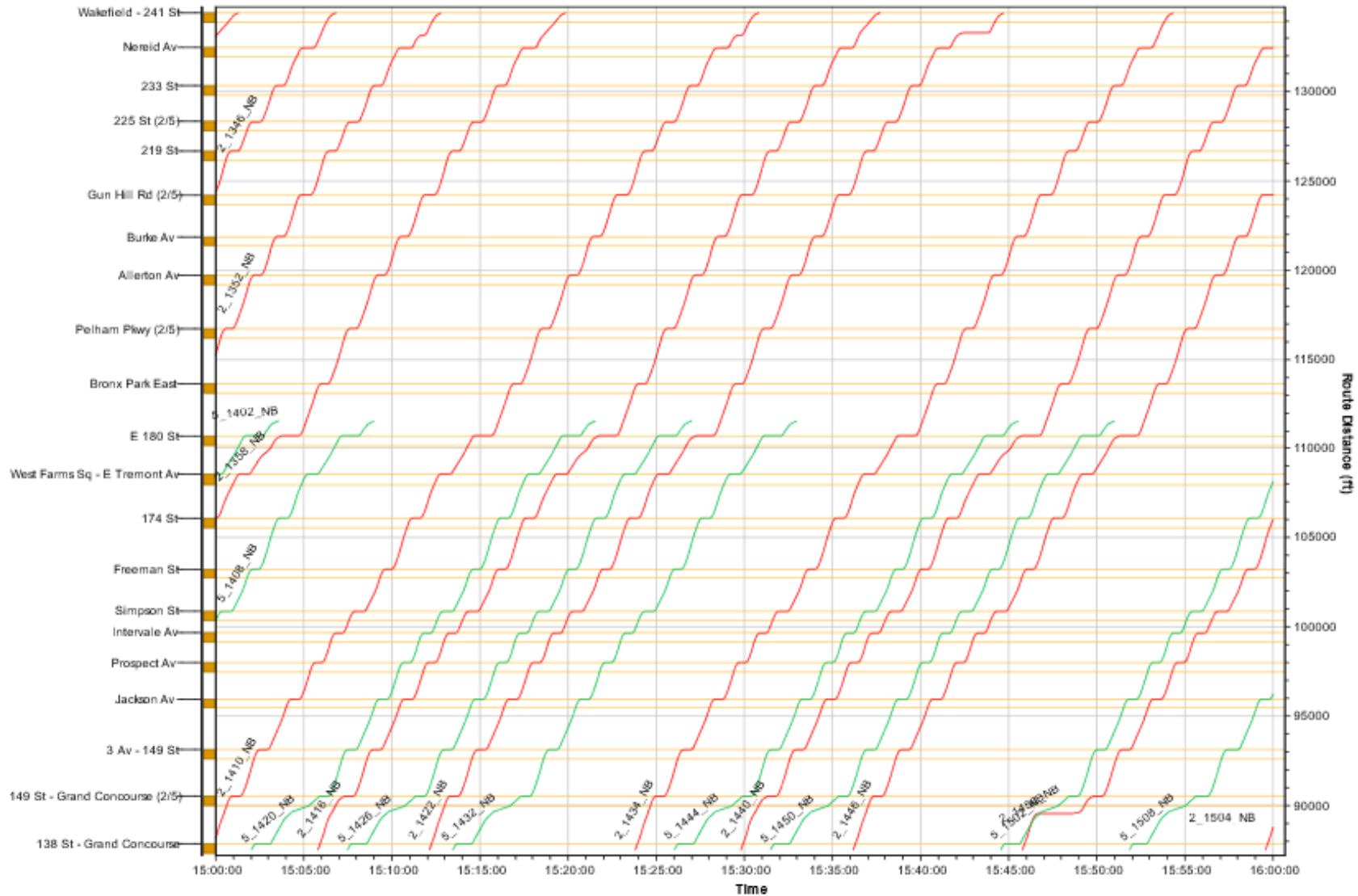
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-84: Future Baseline (CBTC) String Chart – 138 Street-Grand Concourse to Wakefield-241 Street – Northbound – 9:00 to 10:00 a.m.



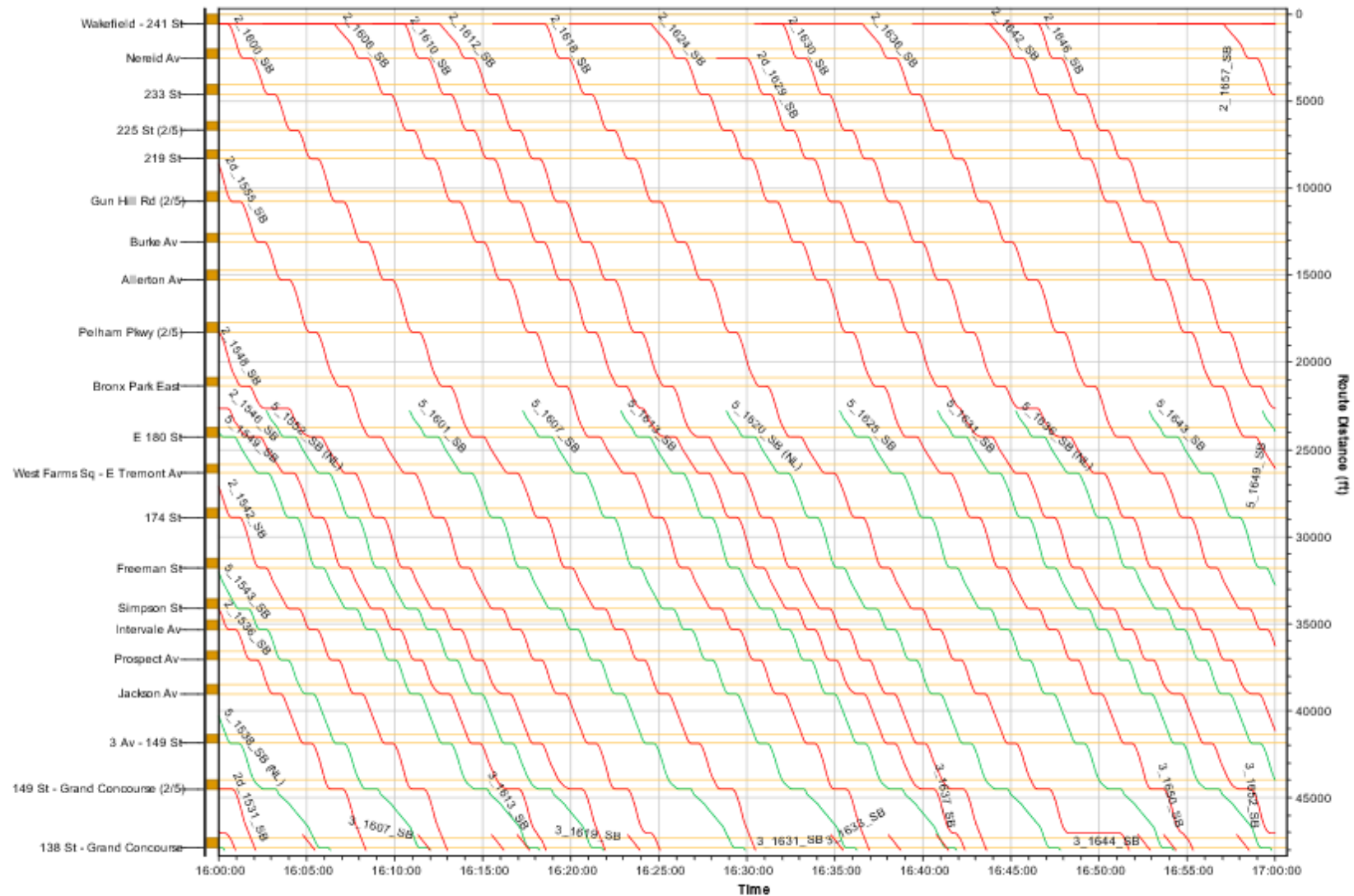
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-85: Future Baseline (CBTC) String Chart – 138 Street-Grand Concourse to Wakefield-241 Street – Northbound – 3:00 to 4:00 p.m.



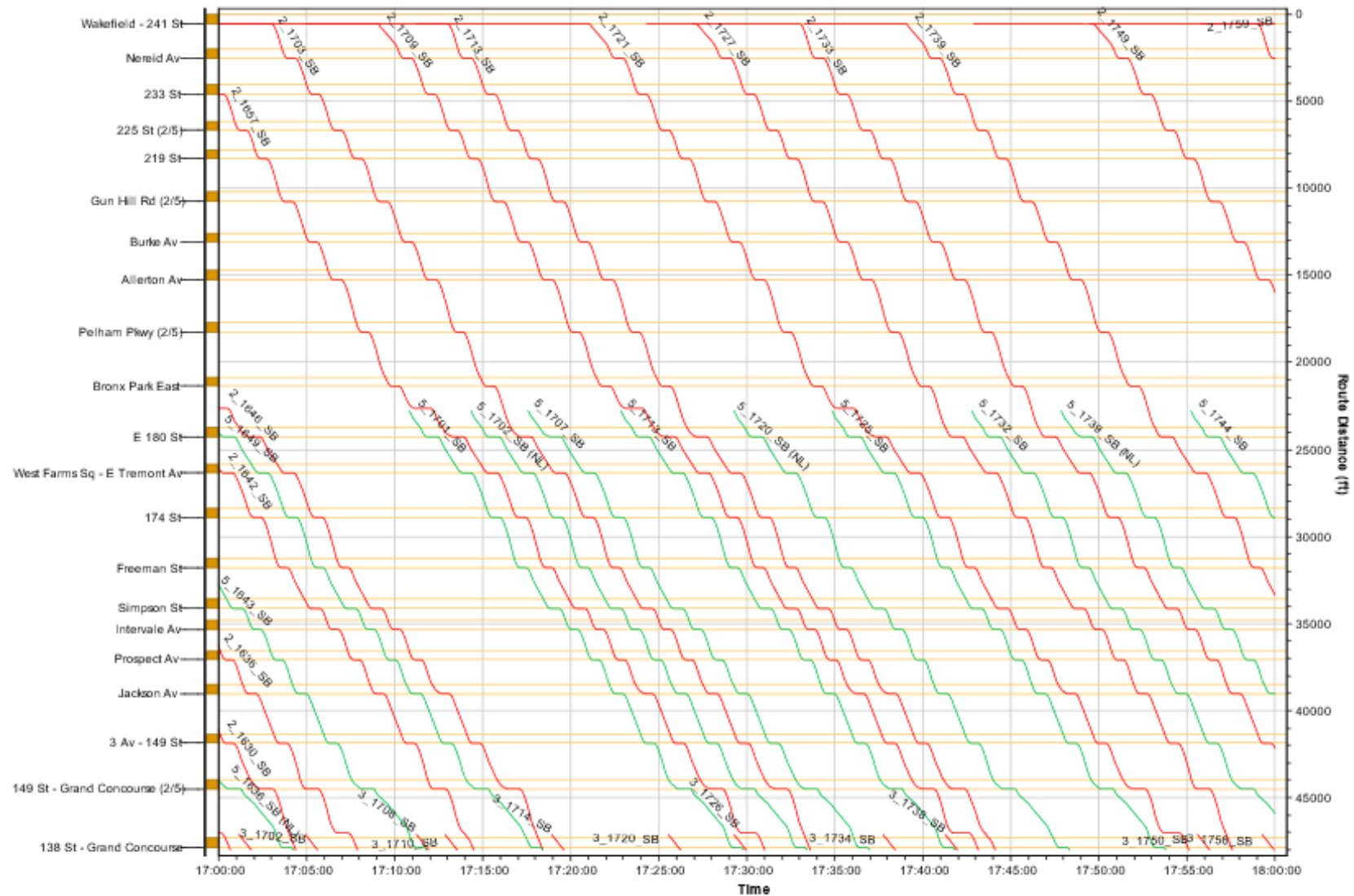
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-86: Future Baseline (CBTC) String Chart – 138 Street-Grand Concourse to Wakefield-241 Street – Northbound – 4:00 to 5:00 p.m.



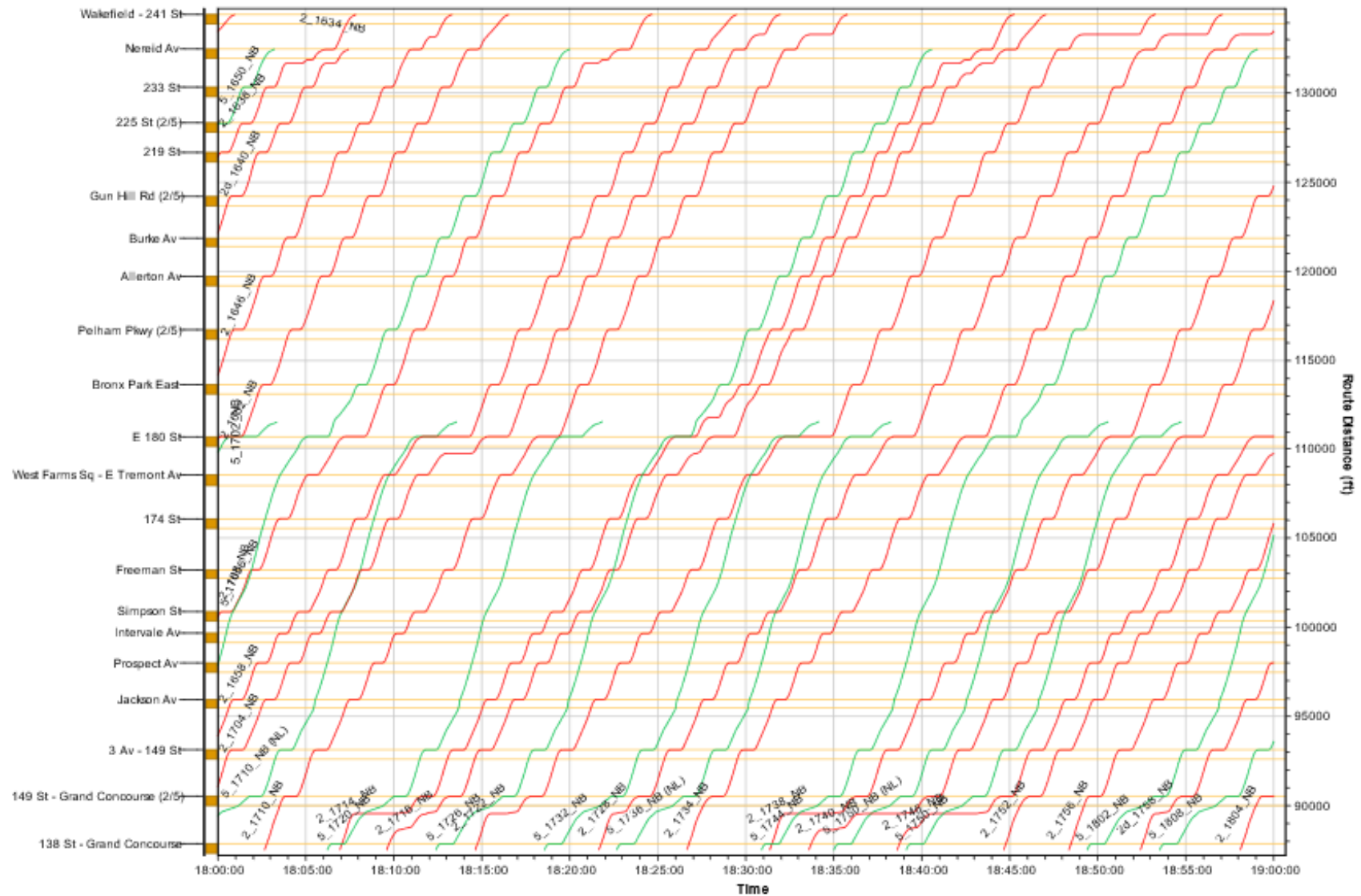
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-87: Future Baseline (CBTC) String Chart – 138 Street-Grand Concourse to Wakefield-241 Street – Northbound – 5:00 to 6:00 p.m.



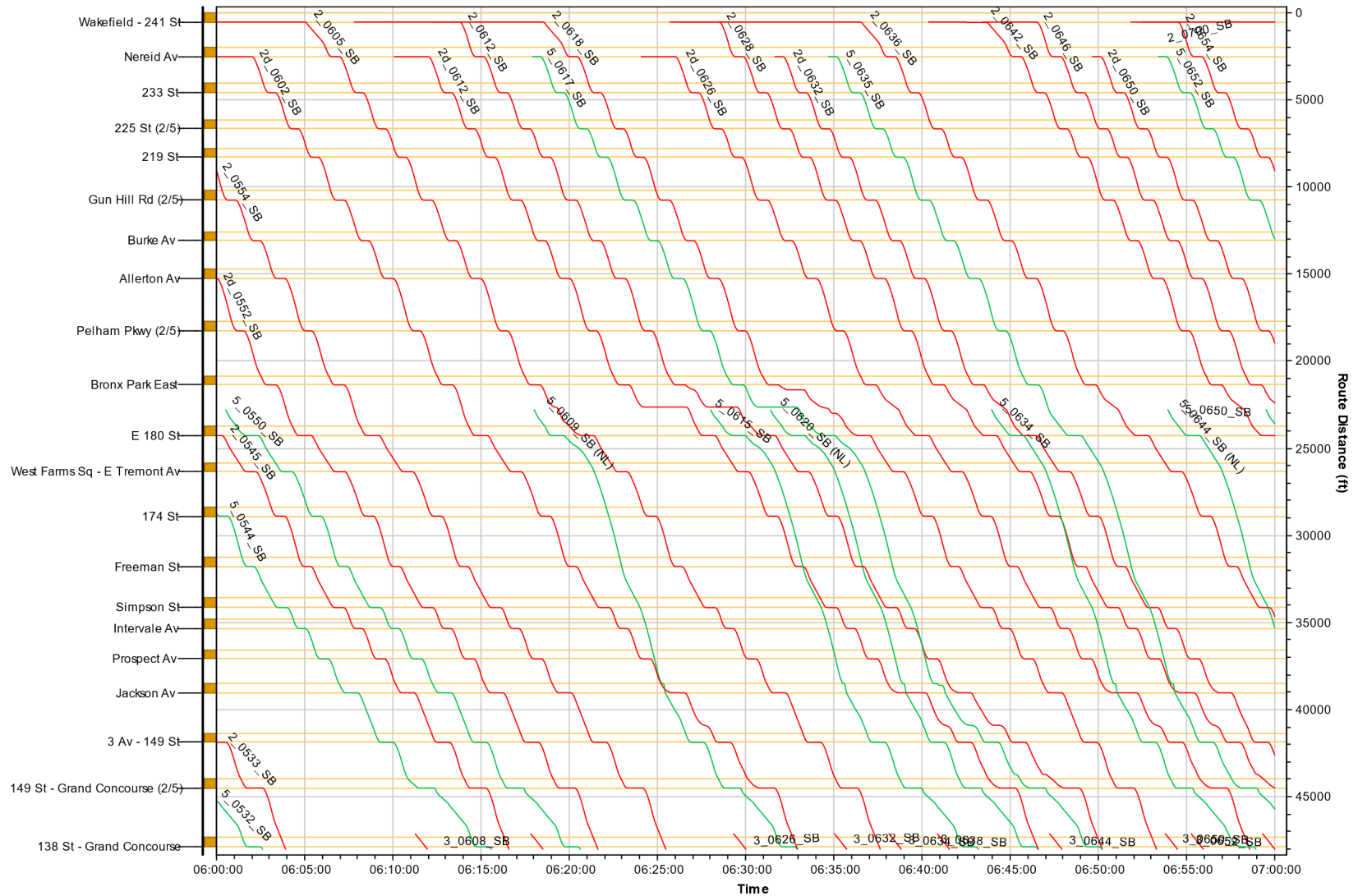
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-88: Future Baseline (CBTC) String Chart – 138 Street-Grand Concourse to Wakefield-241 Street – Northbound – 6:00 to 7:00 p.m.



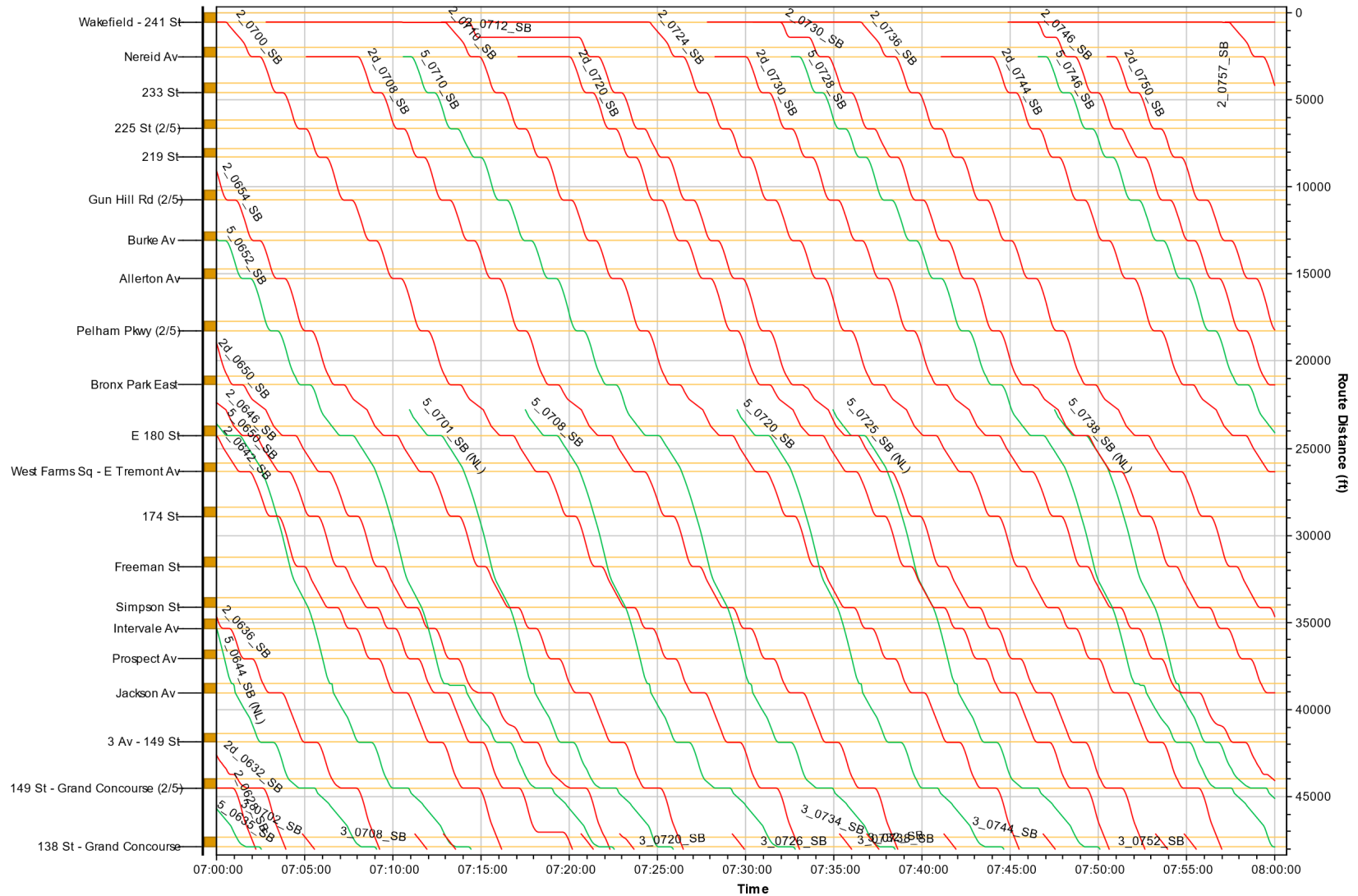
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-89: Future Baseline (CBTC) String Chart – Wakefield-241 Street to 138 Street-Grand Concourse – Southbound – 6:00 to 7:00 a.m.



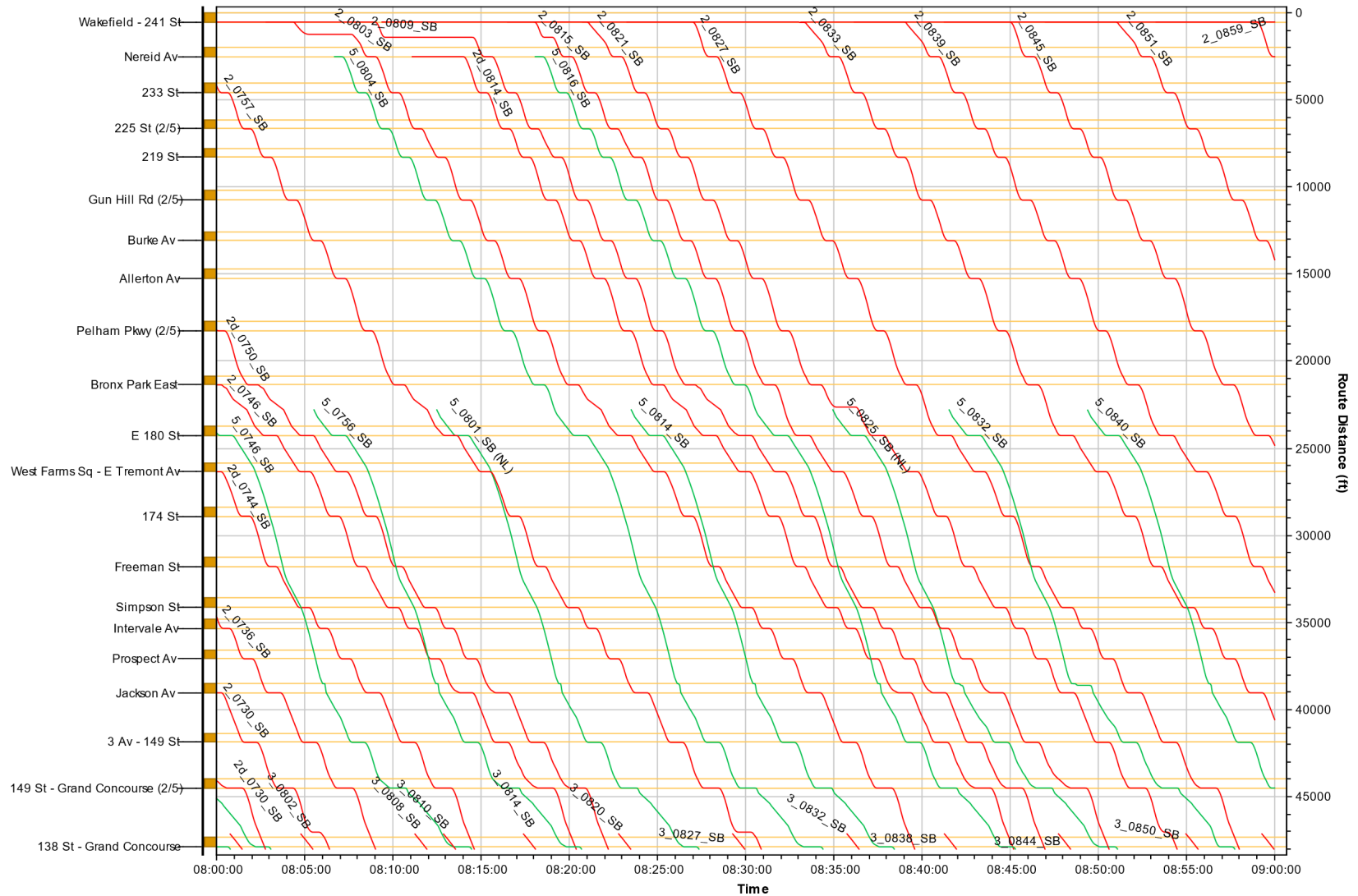
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-90: Future Baseline (CBTC) String Chart – Wakefield-241 Street to 138 Street-Grand Concourse – Southbound – 7:00 to 8:00 a.m.



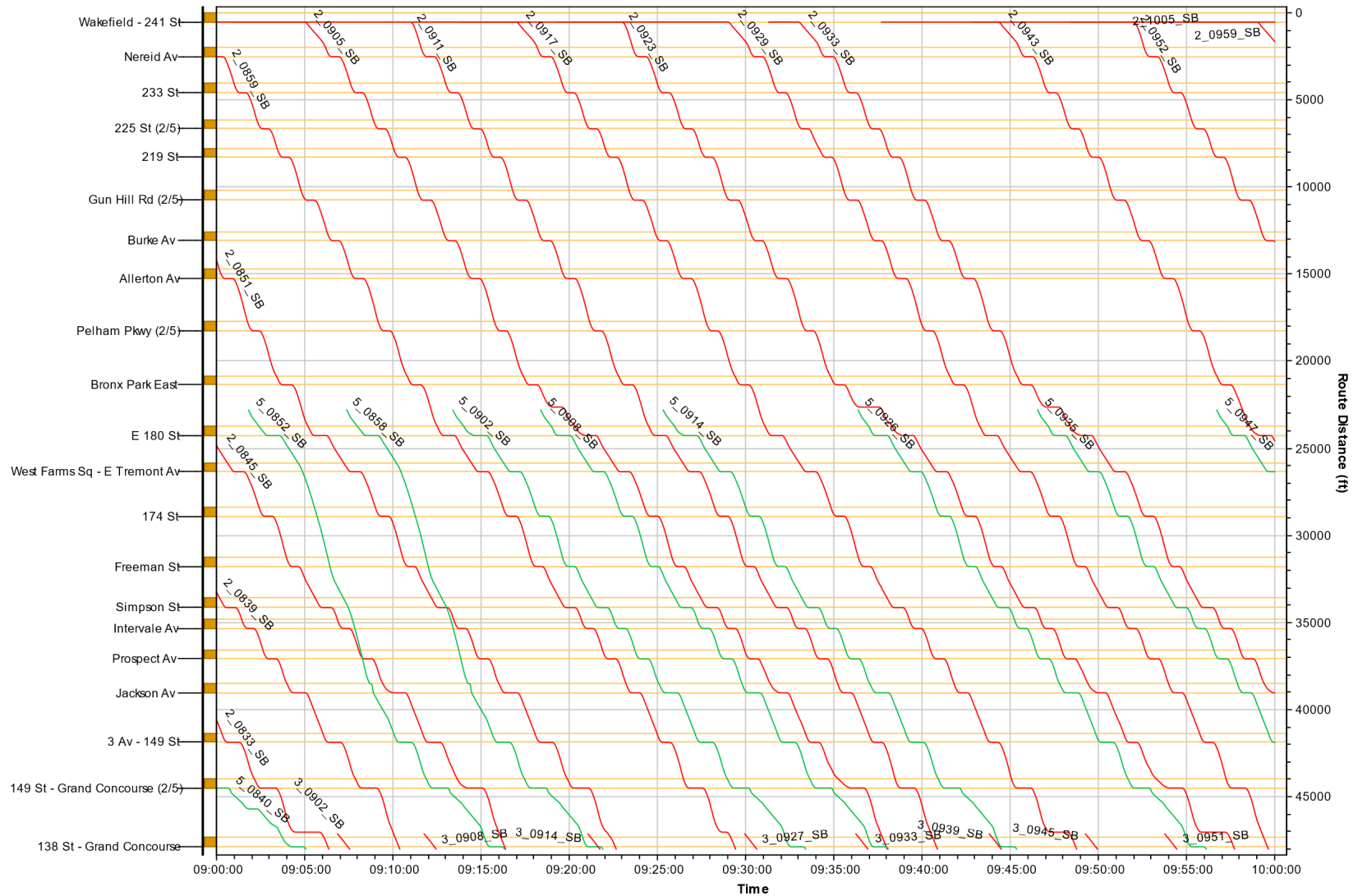
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-91: Future Baseline (CBTC) String Chart – Wakefield-241 Street to 138 Street-Grand Concourse – Southbound – 8:00 to 9:00 a.m.



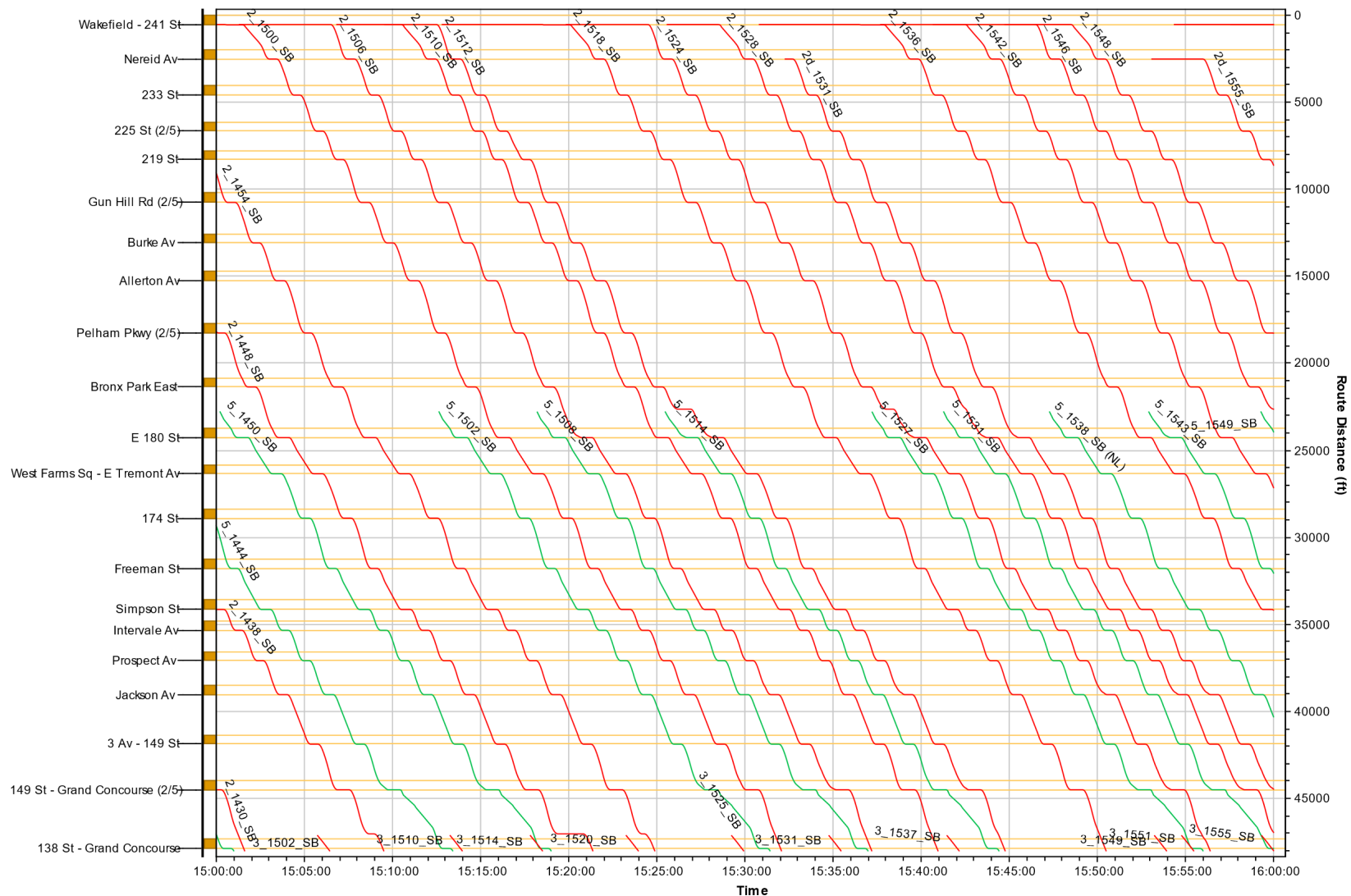
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-92: Future Baseline (CBTC) String Chart – Wakefield-241 Street to 138 Street-Grand Concourse – Southbound – 9:00 to 10:00 a.m.



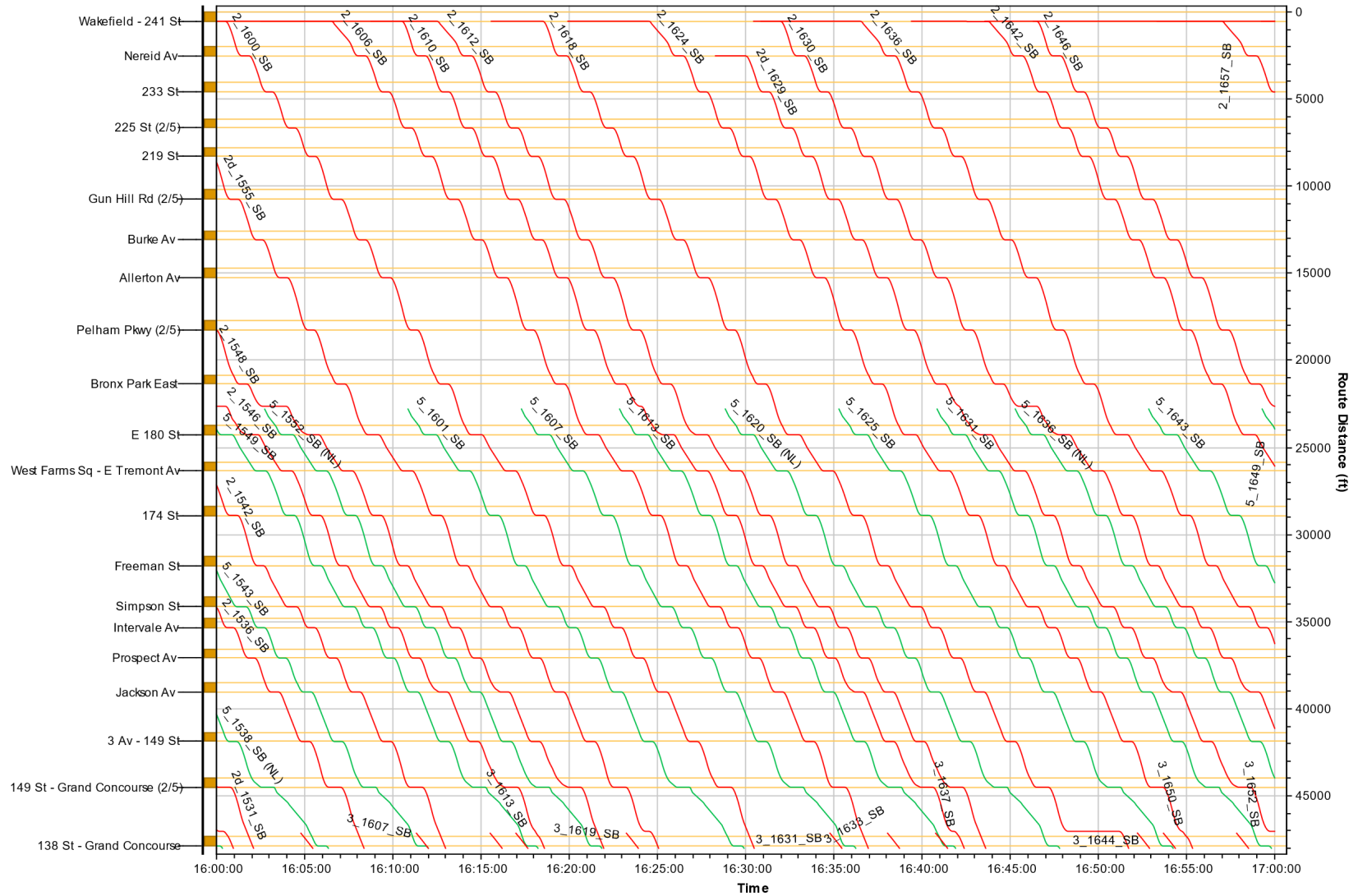
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-93: Future Baseline (CBTC) String Chart – Wakefield-241 Street to 138 Street-Grand Concourse – Southbound – 3:00 to 4:00 p.m.



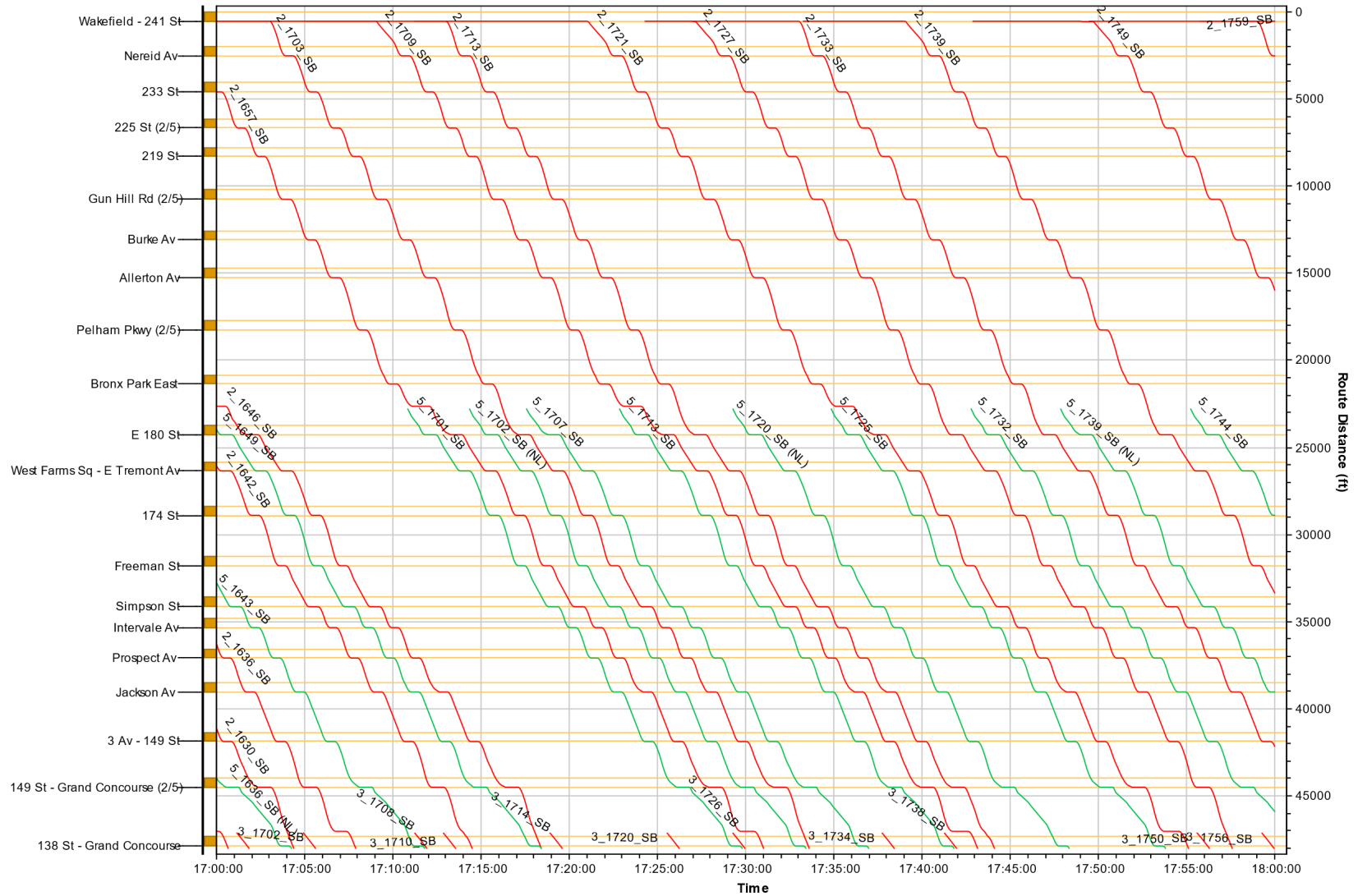
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-94: Future Baseline (CBTC) String Chart – Wakefield-241 Street to 138 Street-Grand Concourse – Southbound – 4:00 to 5:00 p.m.



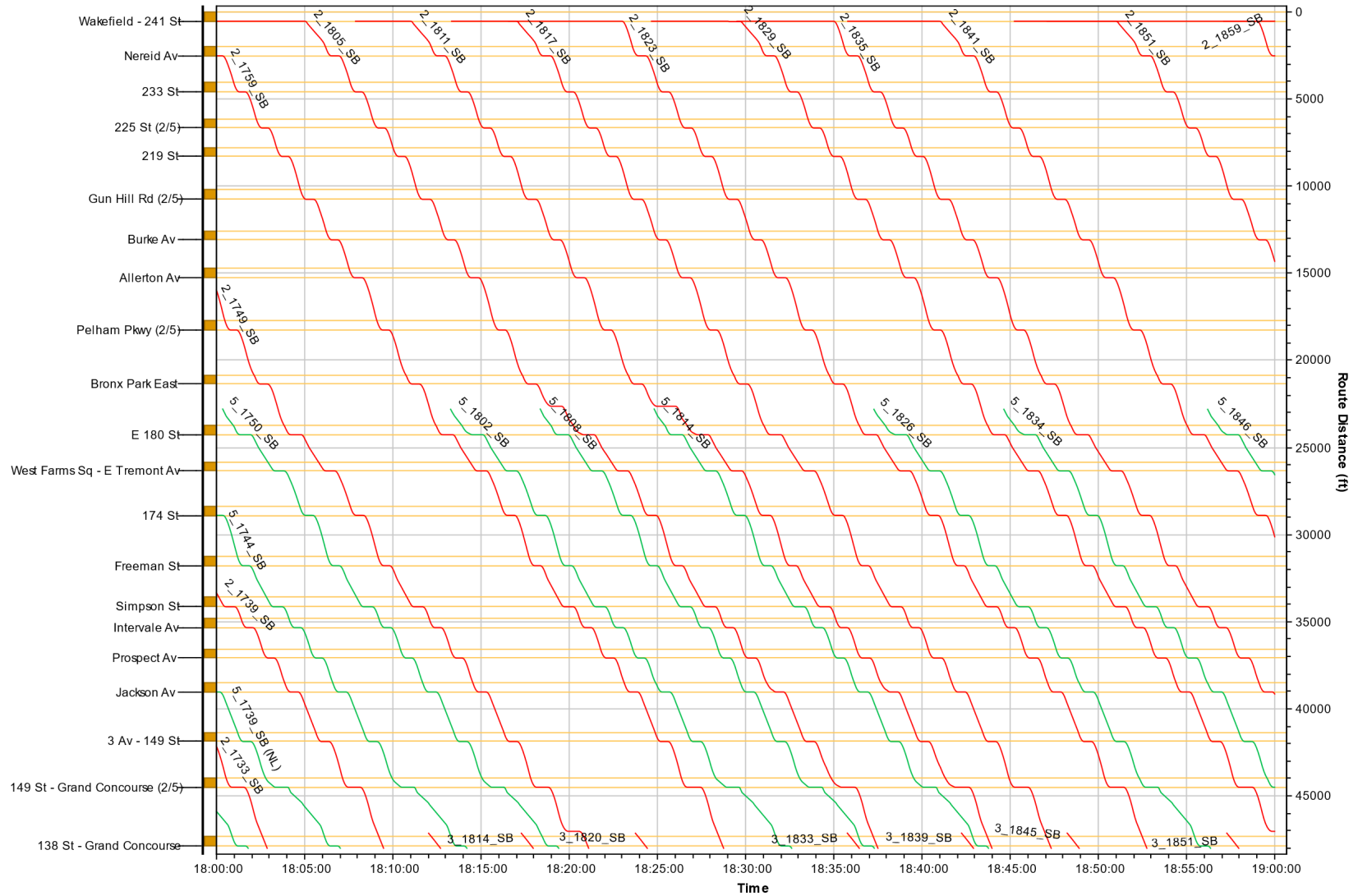
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-95: Future Baseline (CBTC) String Chart – Wakefield-241 Street to 138 Street-Grand Concourse – Southbound – 5:00 to 6:00 p.m.



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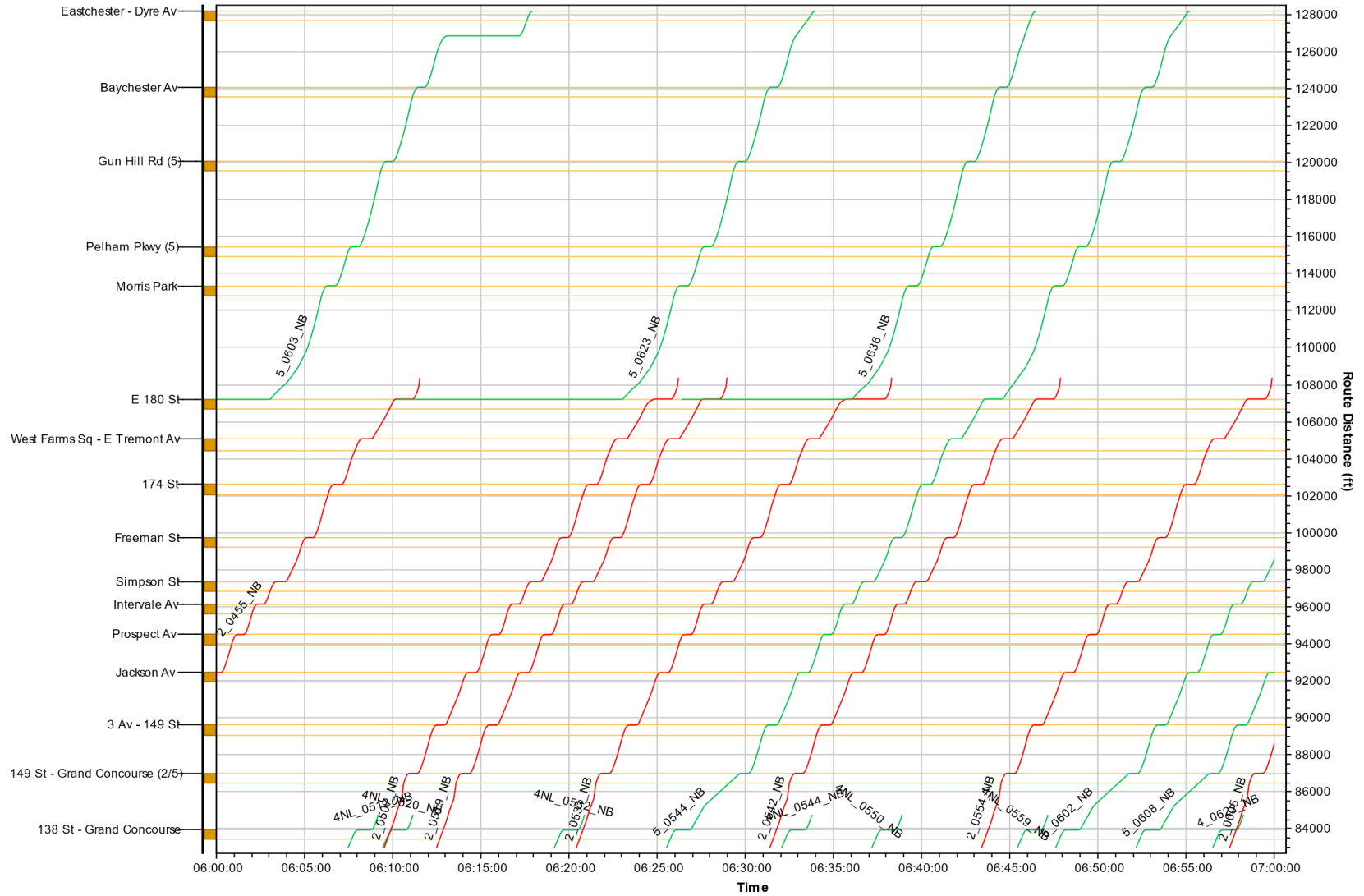
Figure G.4-96: Future Baseline (CBTC) String Chart – Wakefield-241 Street to 138 Street-Grand Concourse – Southbound – 6:00 to 7:00 p.m.



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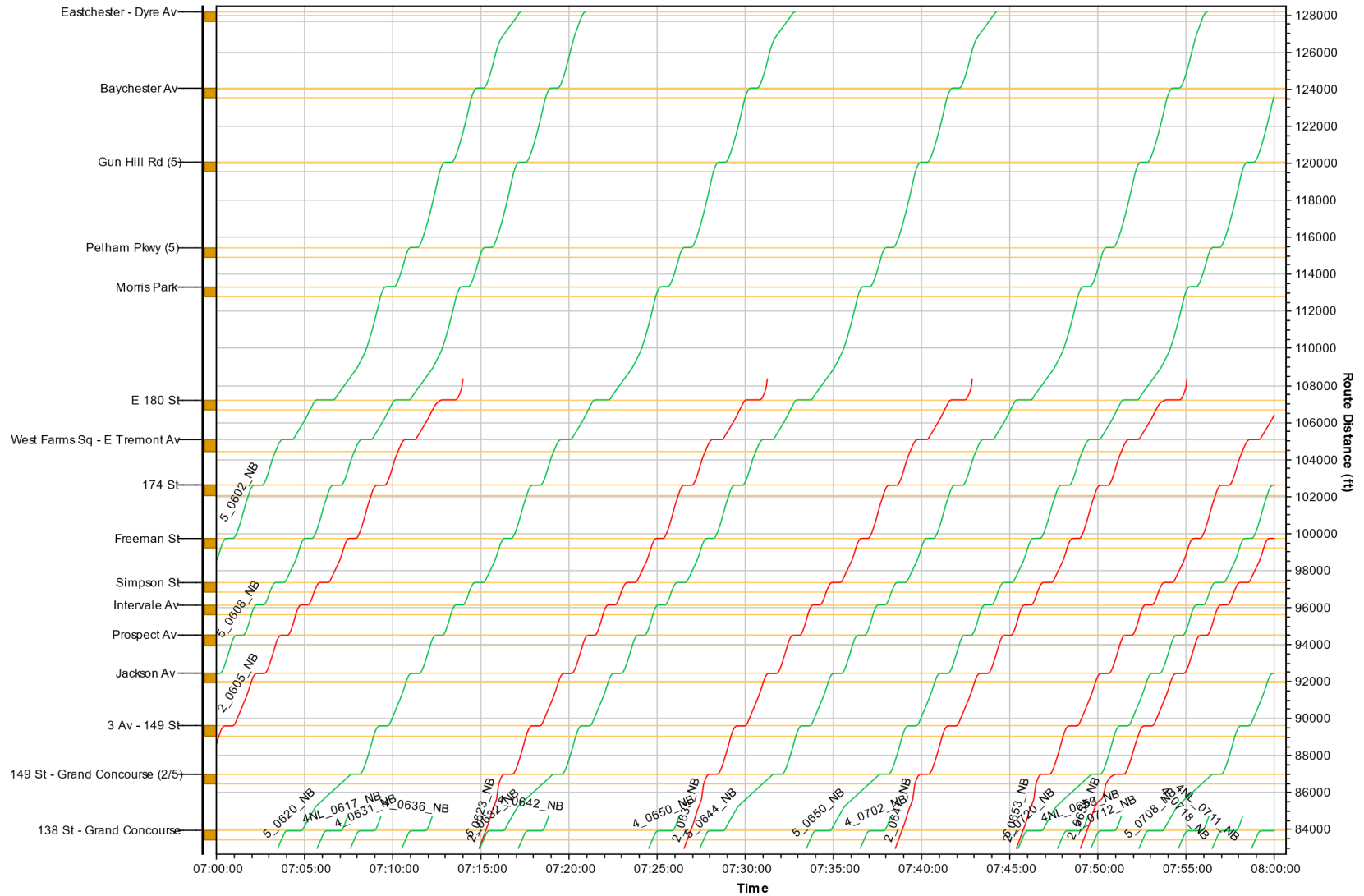
G.4.7 Eastchester-Dyre Avenue to 138 Street-Grand Concourse

Figure G.4-97: Future Baseline (CBTC) String Chart – 138 Street-Grand Concourse to Eastchester-Dyre Avenue – Northbound – 6:00 to 7:00 a.m.



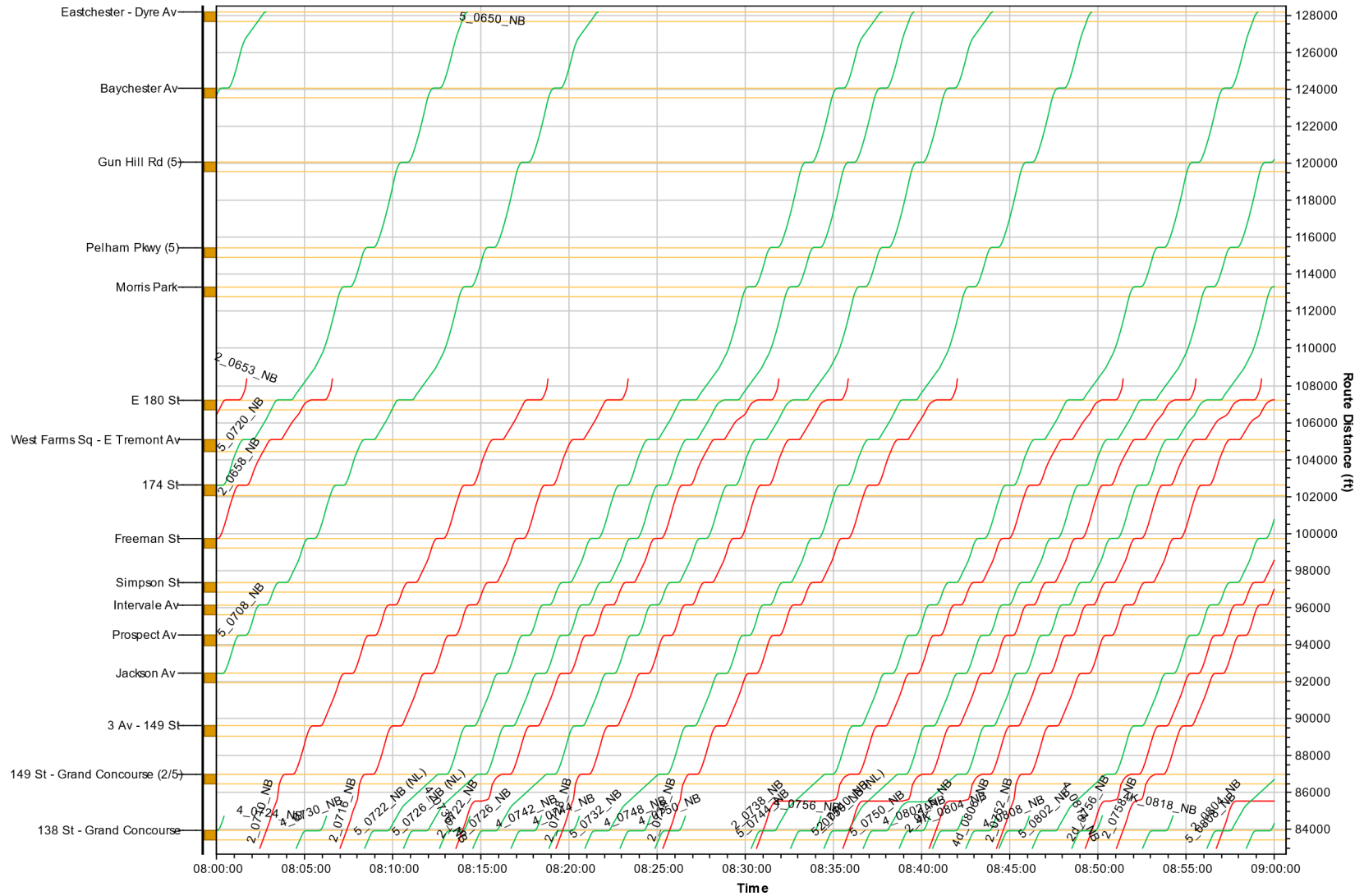
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-98: Future Baseline (CBTC) String Chart – 138 Street-Grand Concourse to Eastchester-Dyre Avenue – Northbound – 7:00 to 8:00 a.m.



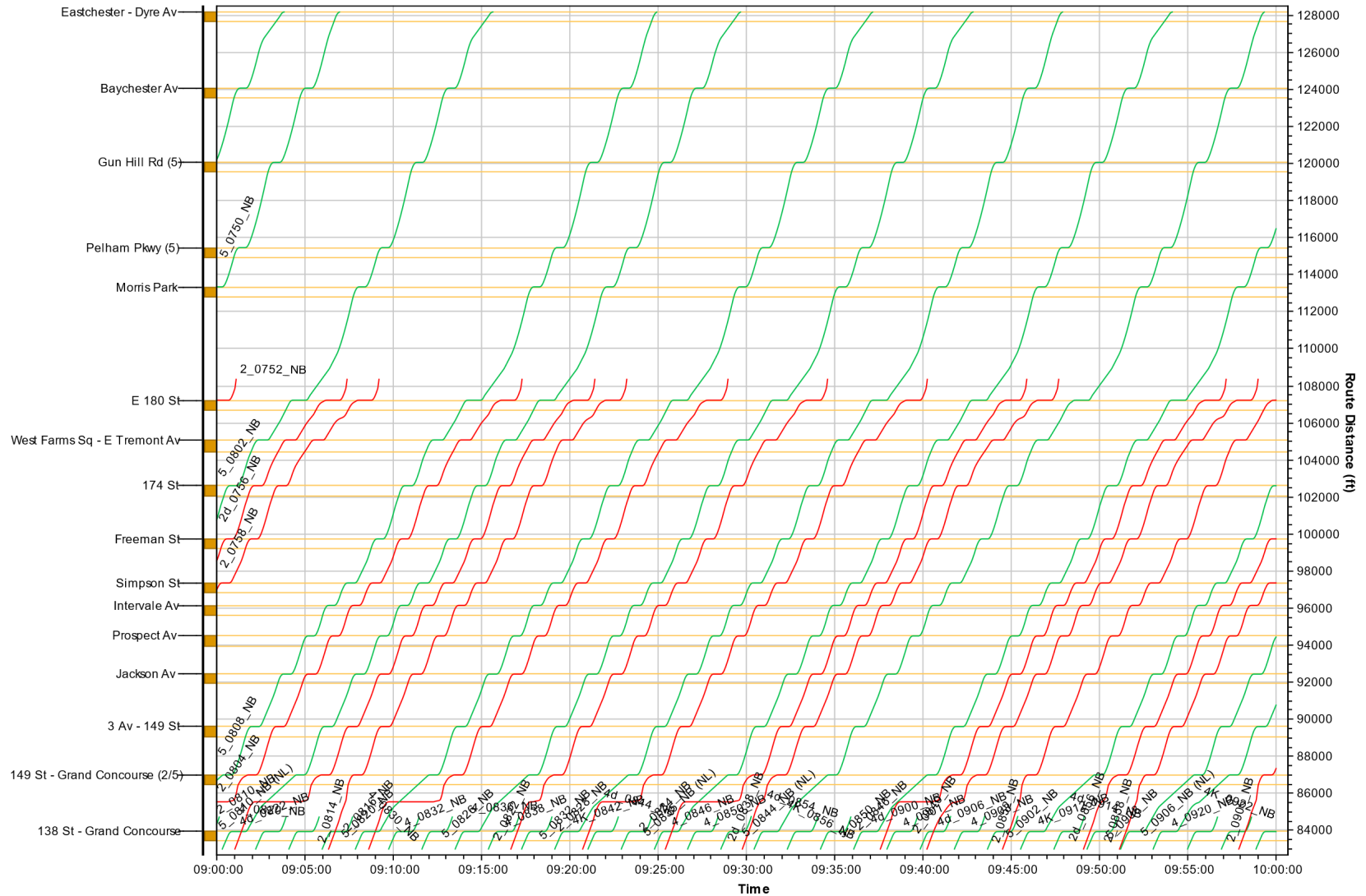
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-99: Future Baseline (CBTC) String Chart – 138 Street-Grand Concourse to Eastchester-Dyre Avenue – Northbound – 8:00 to 9:00 a.m.



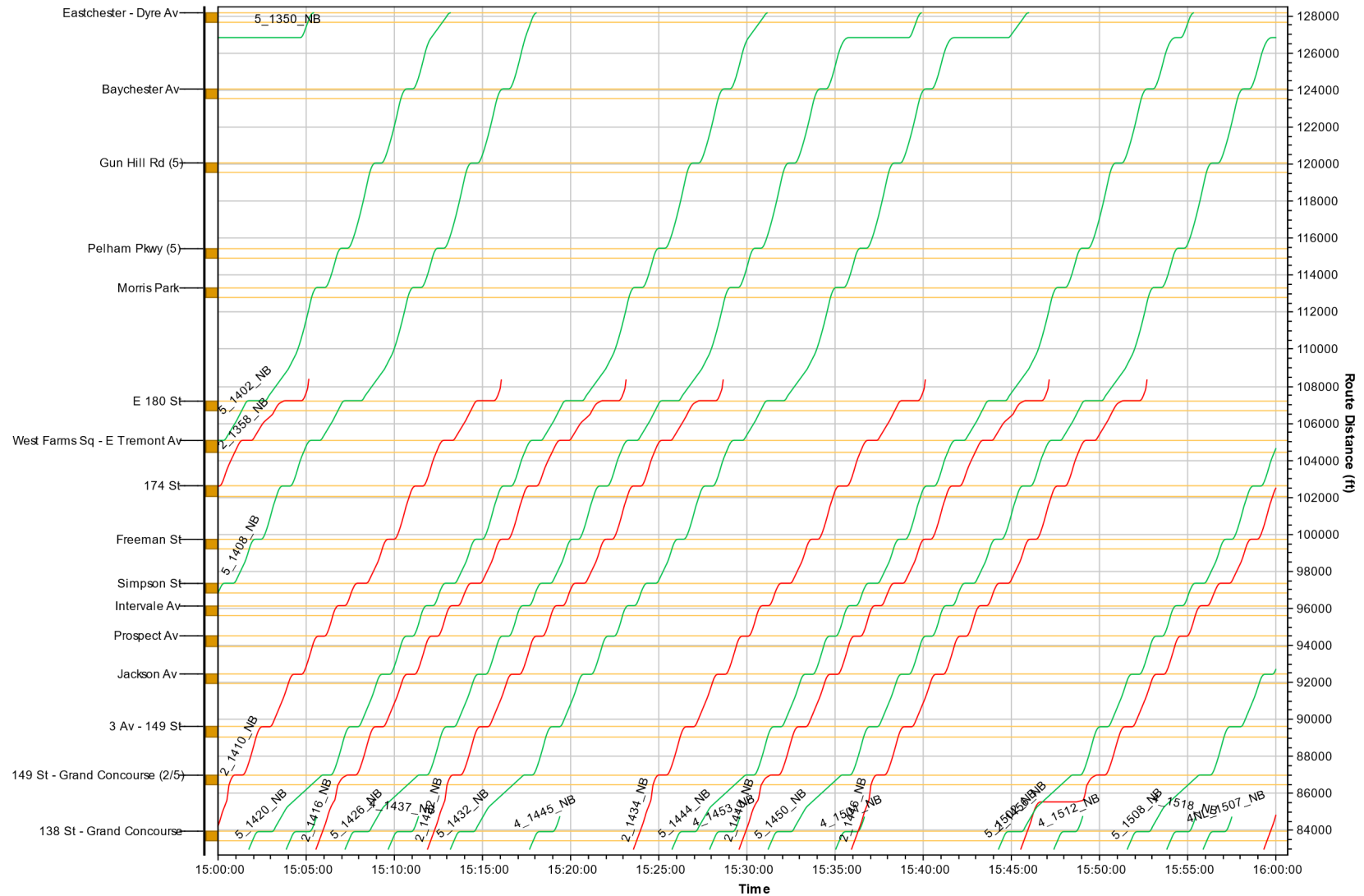
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-100: Future Baseline (CBTC) String Chart – 138 Street-Grand Concourse to Eastchester-Dyre Avenue– Northbound – 9:00 to 10:00 a.m.



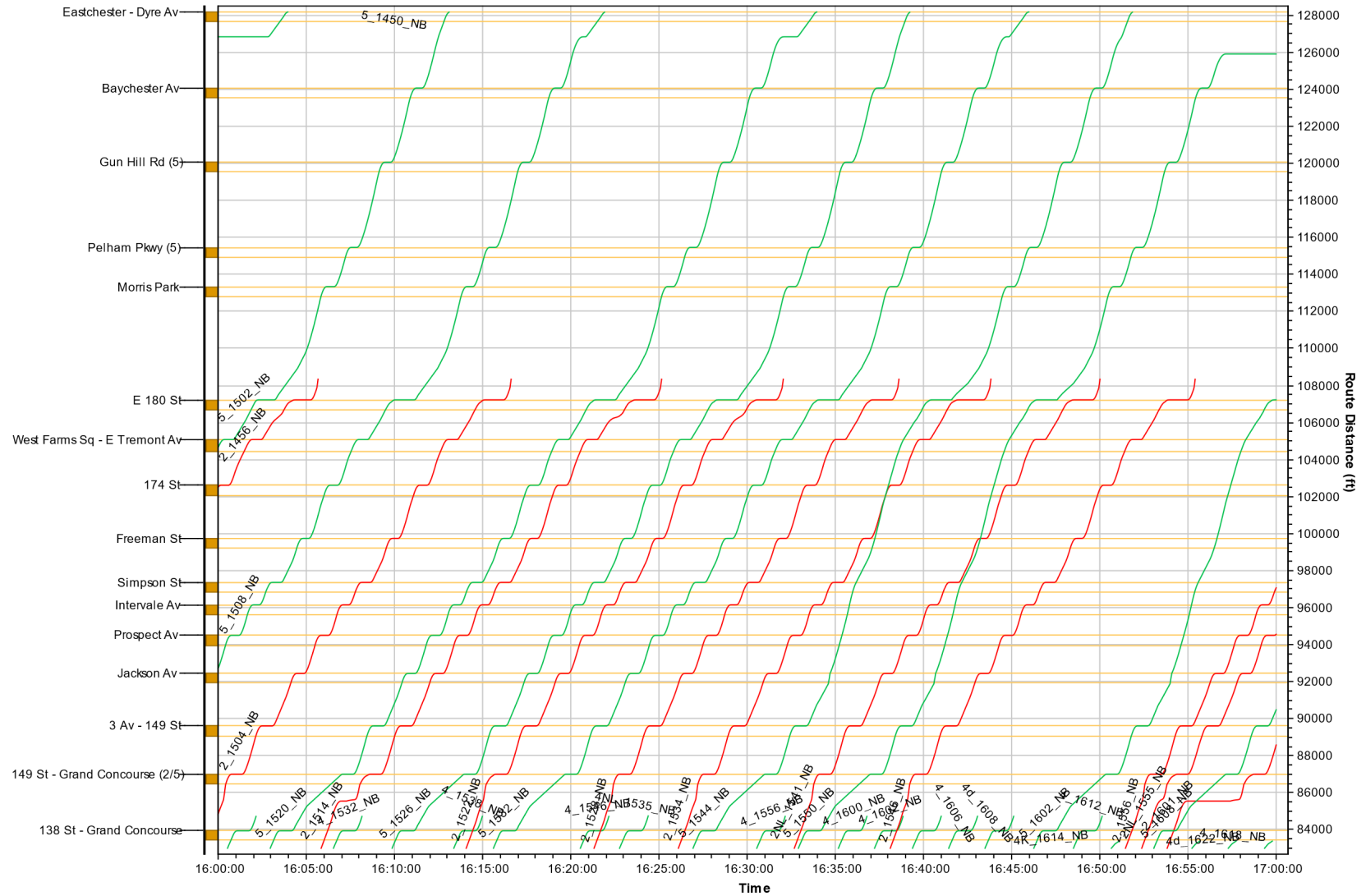
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-101: Future Baseline (CBTC) String Chart – 138 Street-Grand Concourse to Eastchester-Dyre Avenue – Northbound – 3:00 to 4:00 p.m.



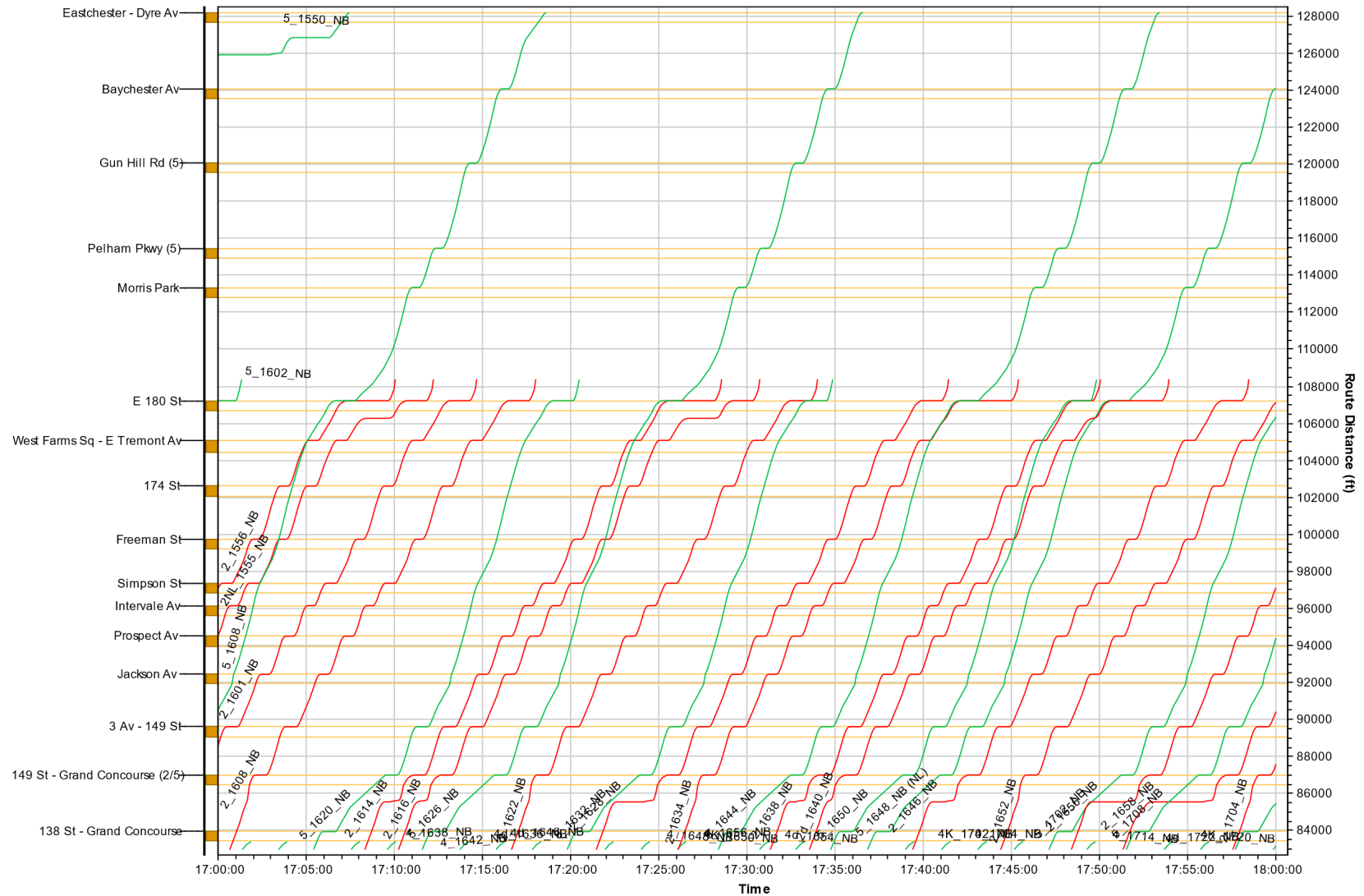
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-102: Future Baseline (CBTC) String Chart – 138 Street-Grand Concourse to Eastchester-Dyre Avenue - Northbound – 4:00 to 5:00 p.m.



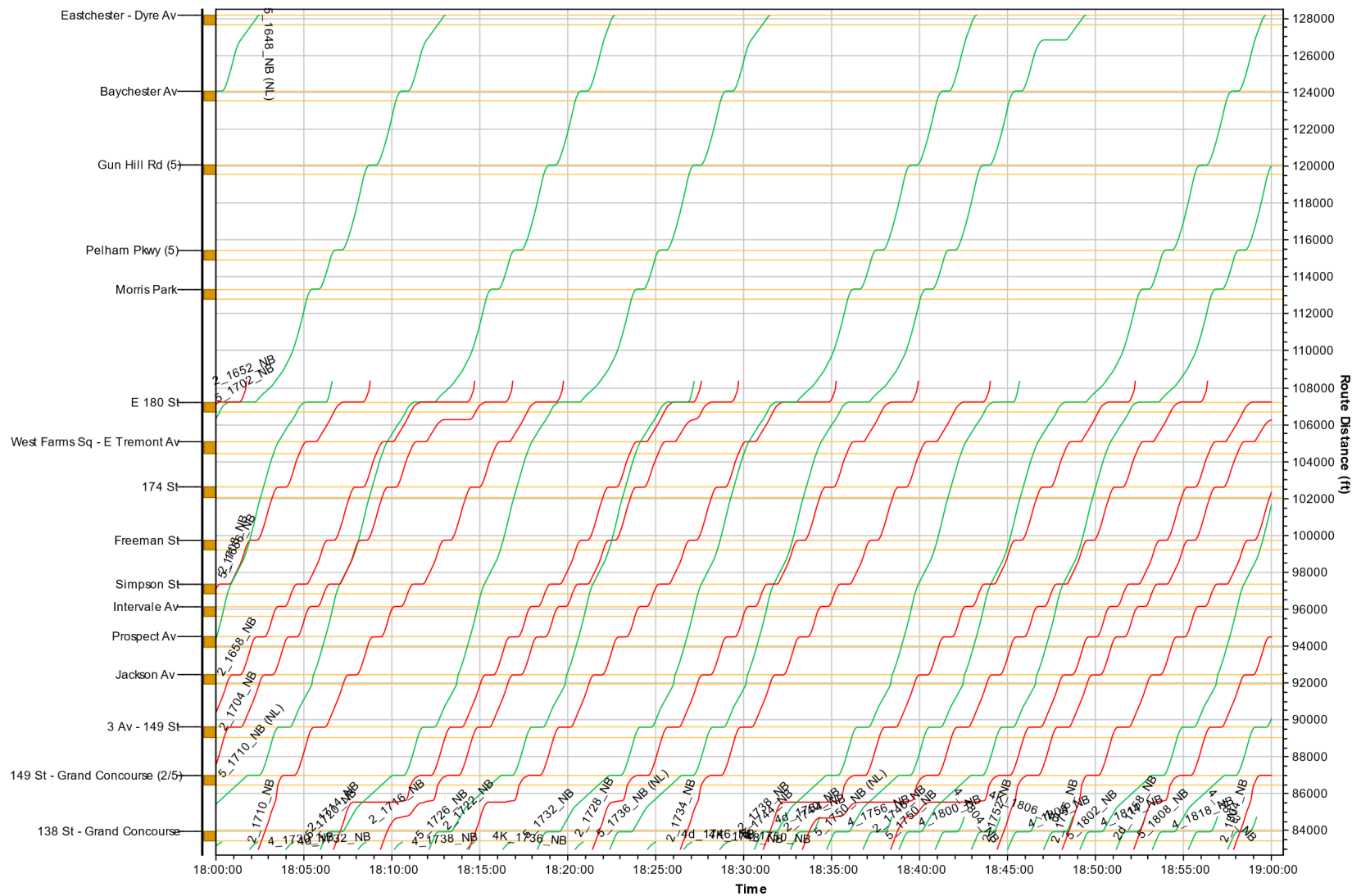
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Figure G.4-103: Future Baseline (CBTC) String Chart - 138 Street-Grand Concourse to Eastchester-Dyre Avenue – Northbound – 5:00 to 6:00 p.m.



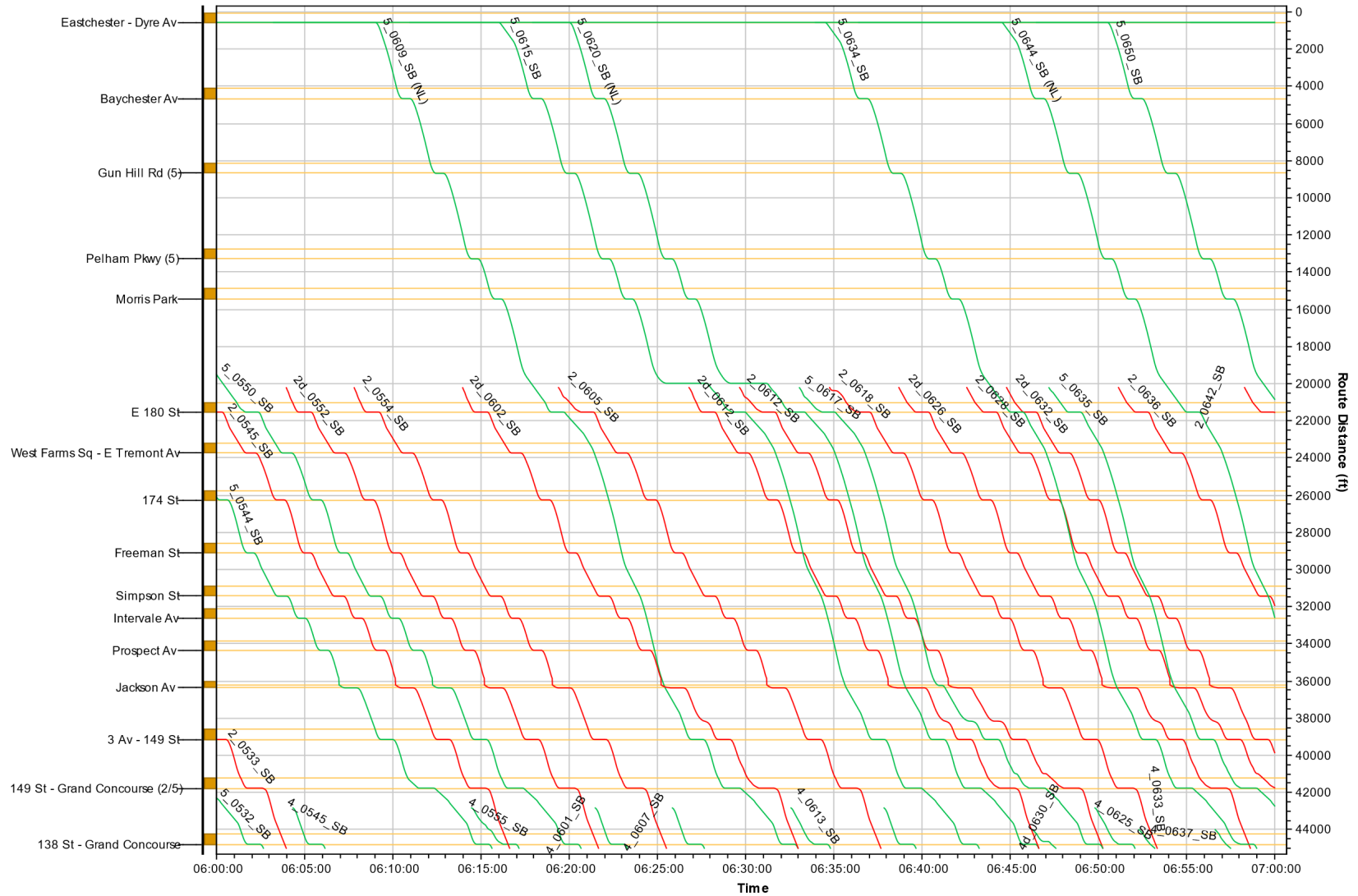
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-104: Future Baseline (CBTC) String Chart – 138 Street-Grand Concourse to Eastchester-Dyre Avenue – Northbound – 6:00 to 7:00 p.m.



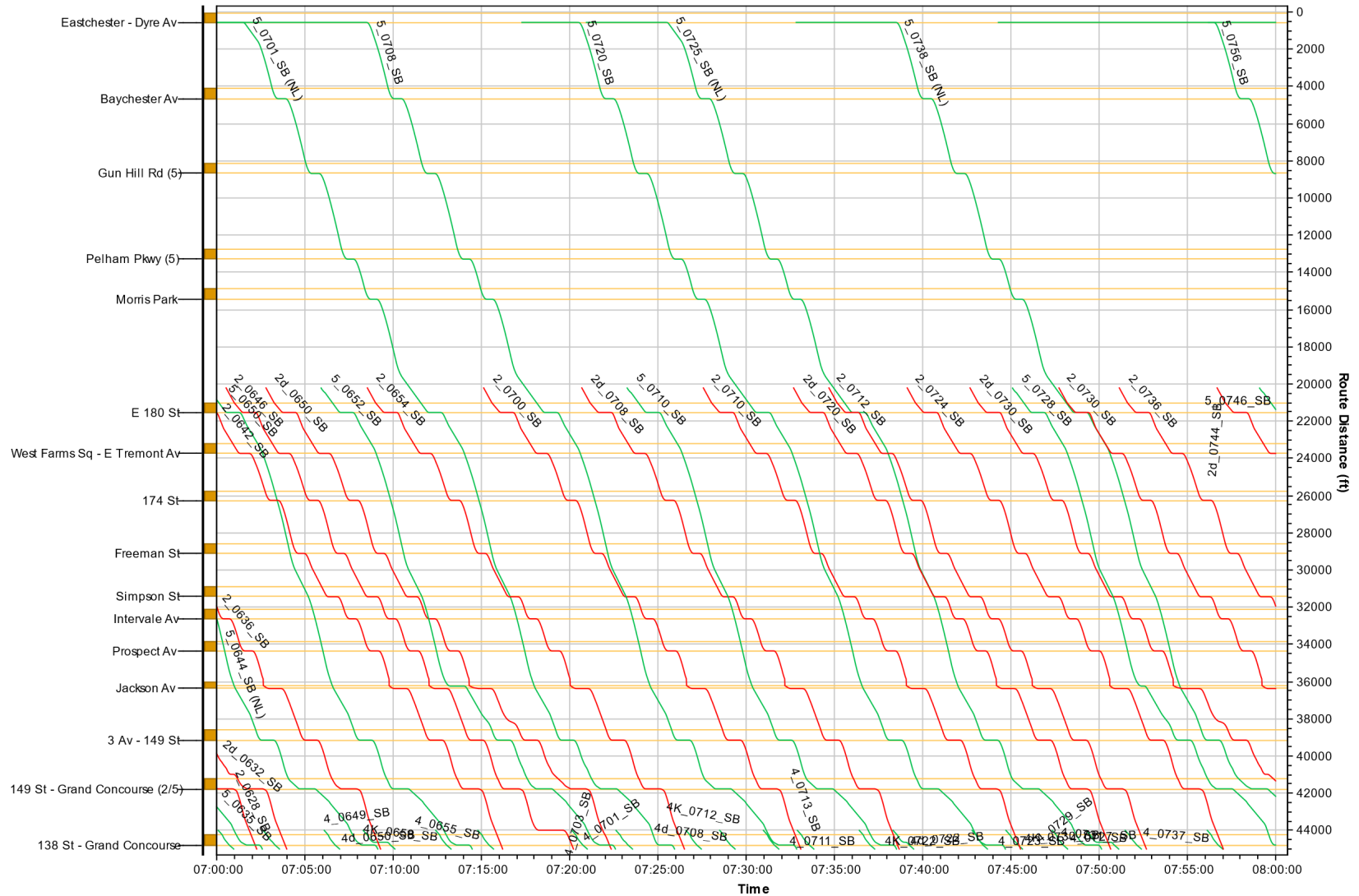
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Figure G.4-105: Future Baseline (CBTC) String Chart – Eastchester-Dyre Avenue to 138 Street-Grand Concourse – Southbound – 6:00 to 7:00 a.m.



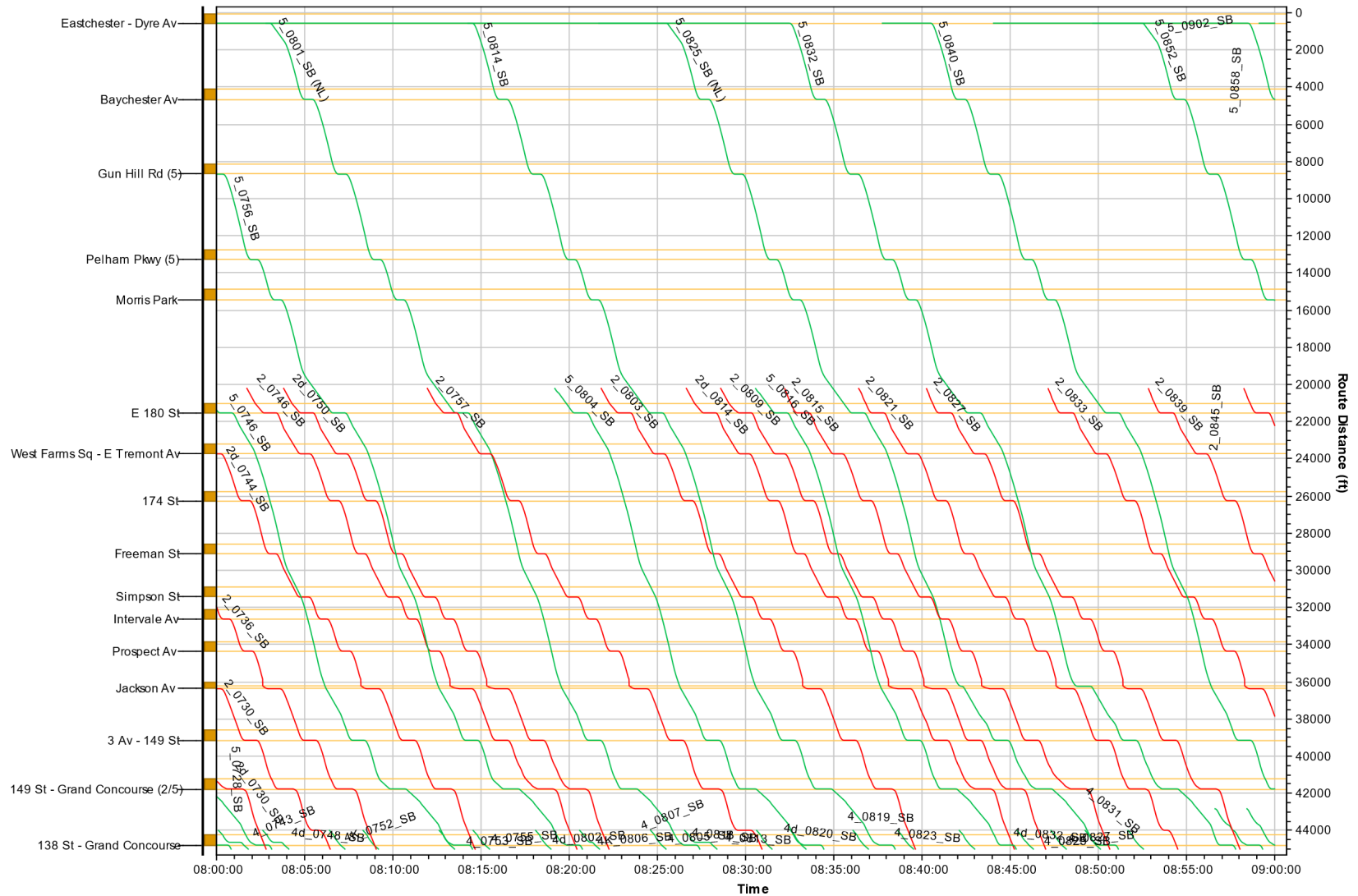
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-106: Future Baseline (CBTC) String Chart – Eastchester-Dyre Avenue to 138 Street-Grand Concourse – Southbound – 7:00 to 8:00 a.m.



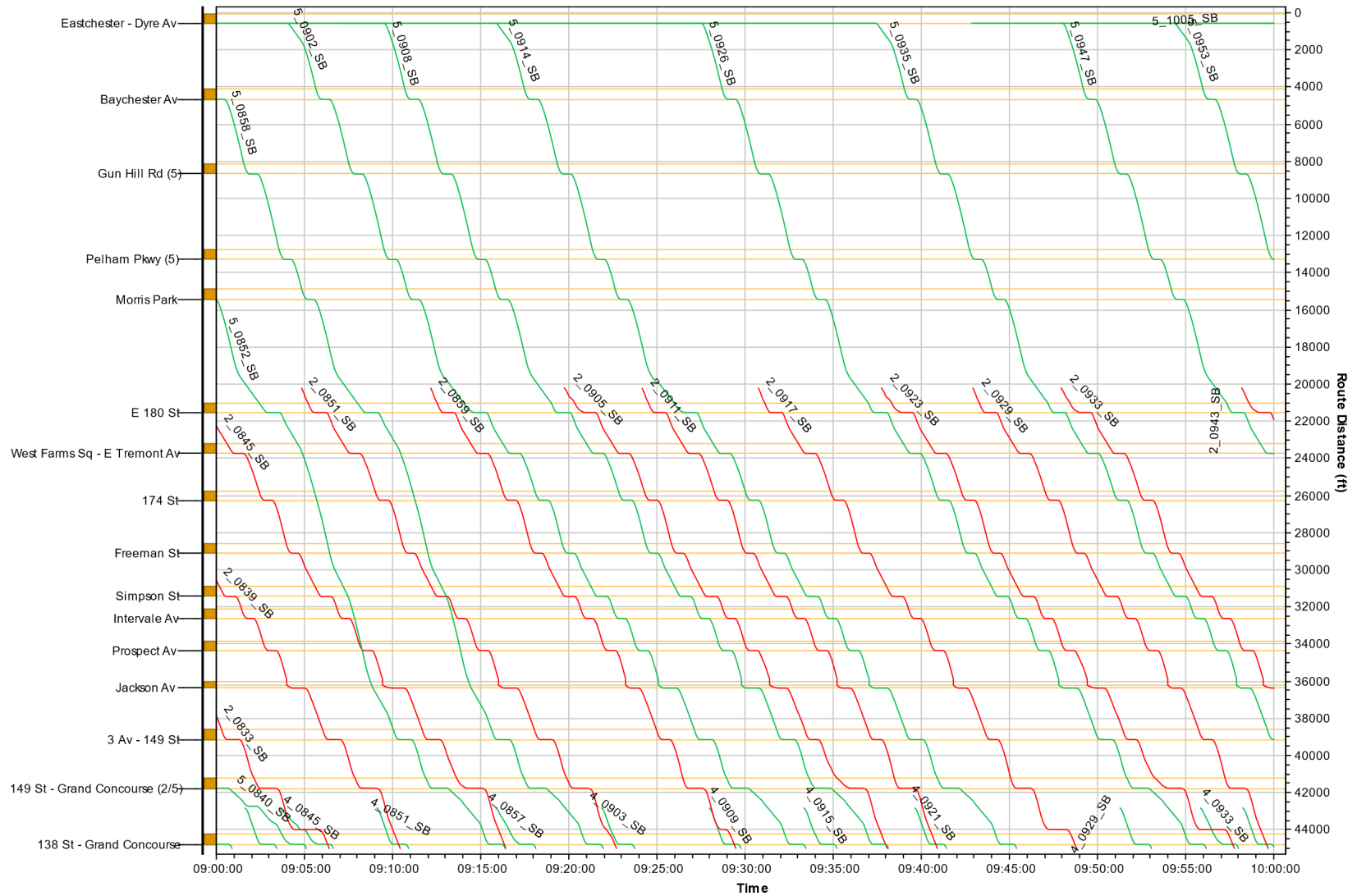
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-107: Future Baseline (CBTC) String Chart – Eastchester-Dyre Avenue to 138 Street-Grand Concourse – Southbound – 8:00 to 9:00 a.m.



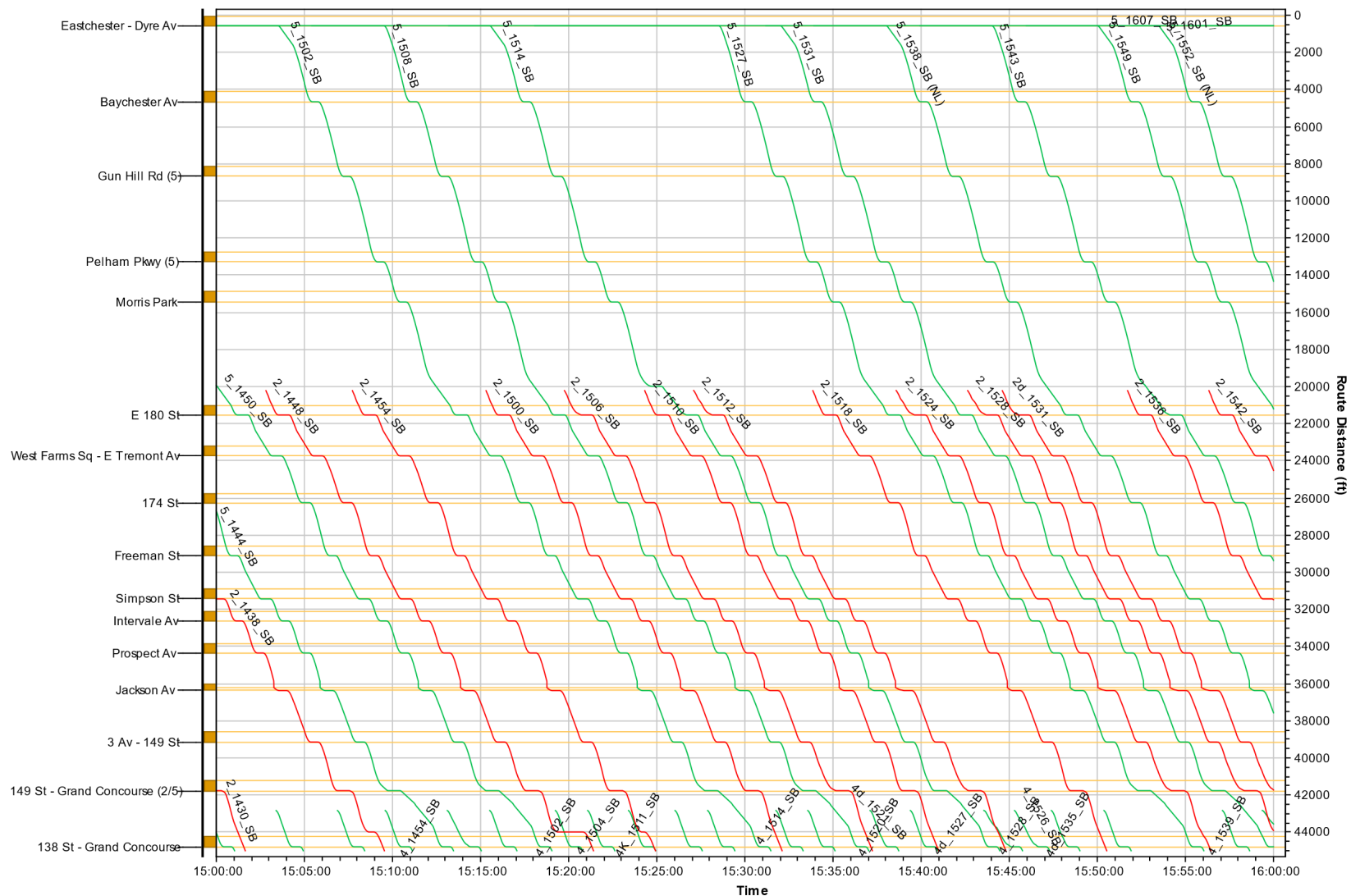
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-108: Future Baseline (CBTC) String Chart – Eastchester-Dyre Avenue to 138 Street-Grand Concourse – Southbound – 9:00 to 10:00 a.m.



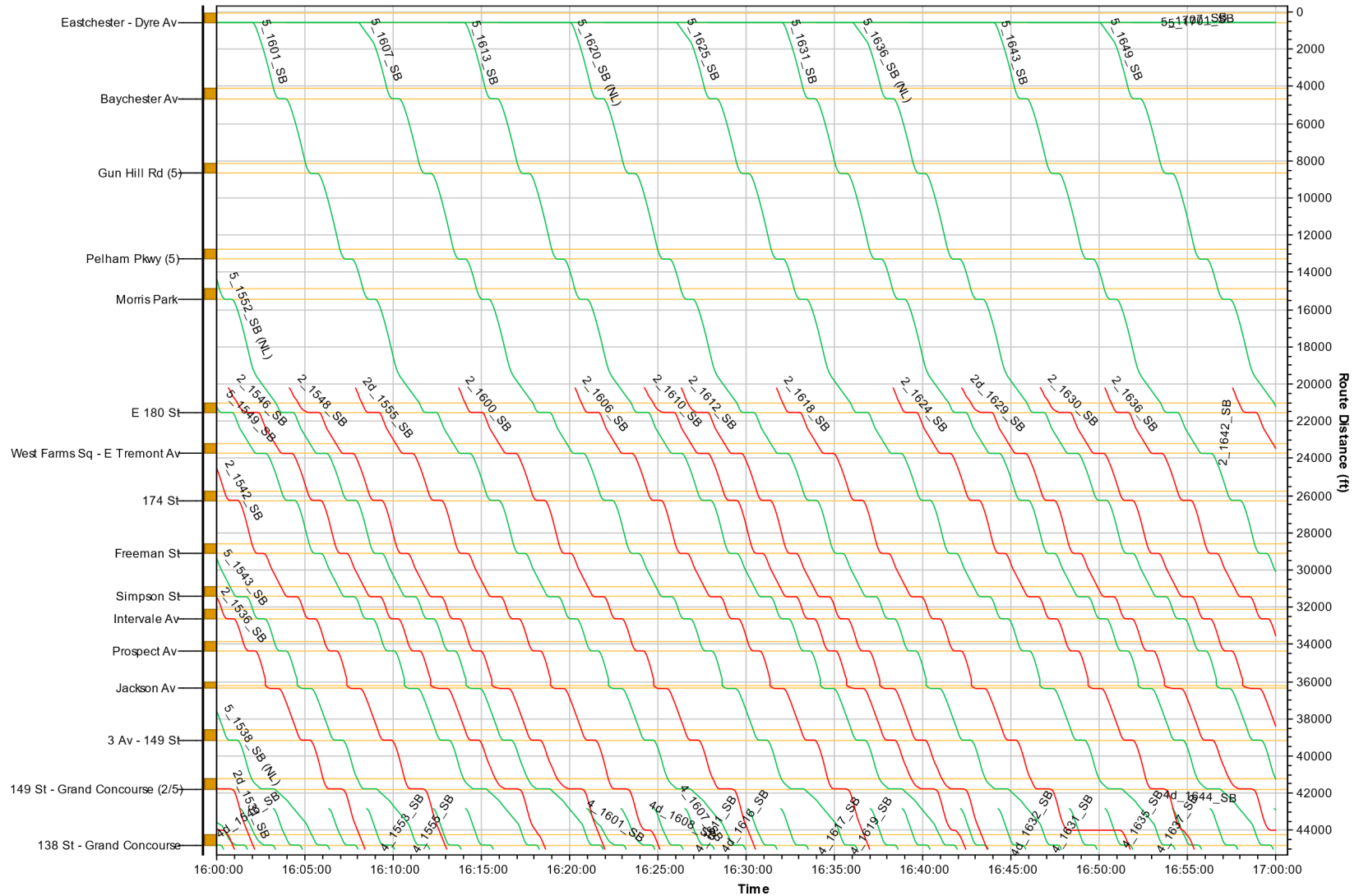
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Figure G.4-109: Future Baseline (CBTC) String Chart – Eastchester-Dyre Avenue to 138 Street-Grand Concourse – Southbound – 3:00 to 4:00 p.m.



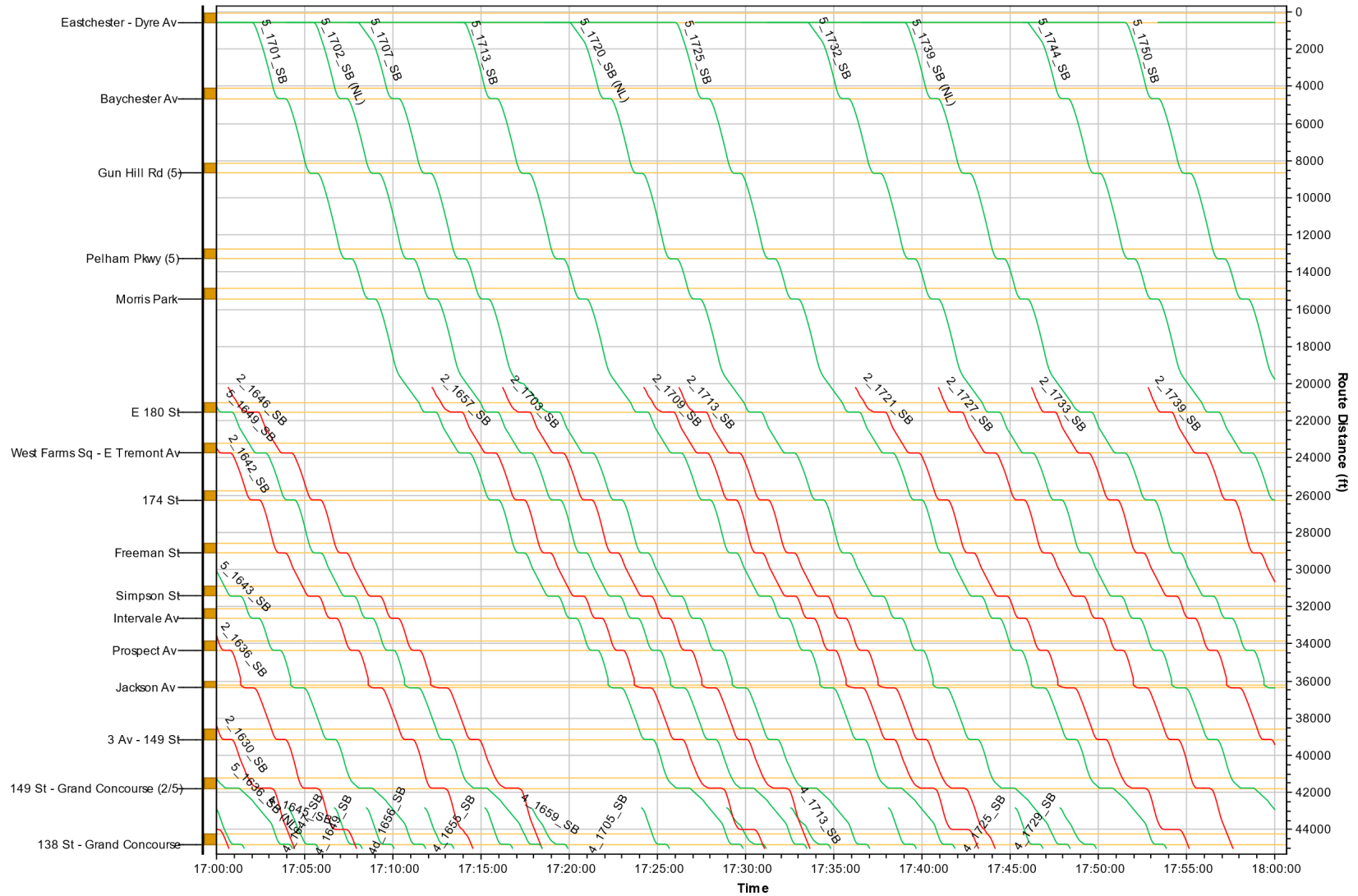
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-110: Future Baseline (CBTC) String Chart – Eastchester-Dyre Avenue to 138 Street-Grand Concourse – Southbound – 4:00 to 5:00 p.m.



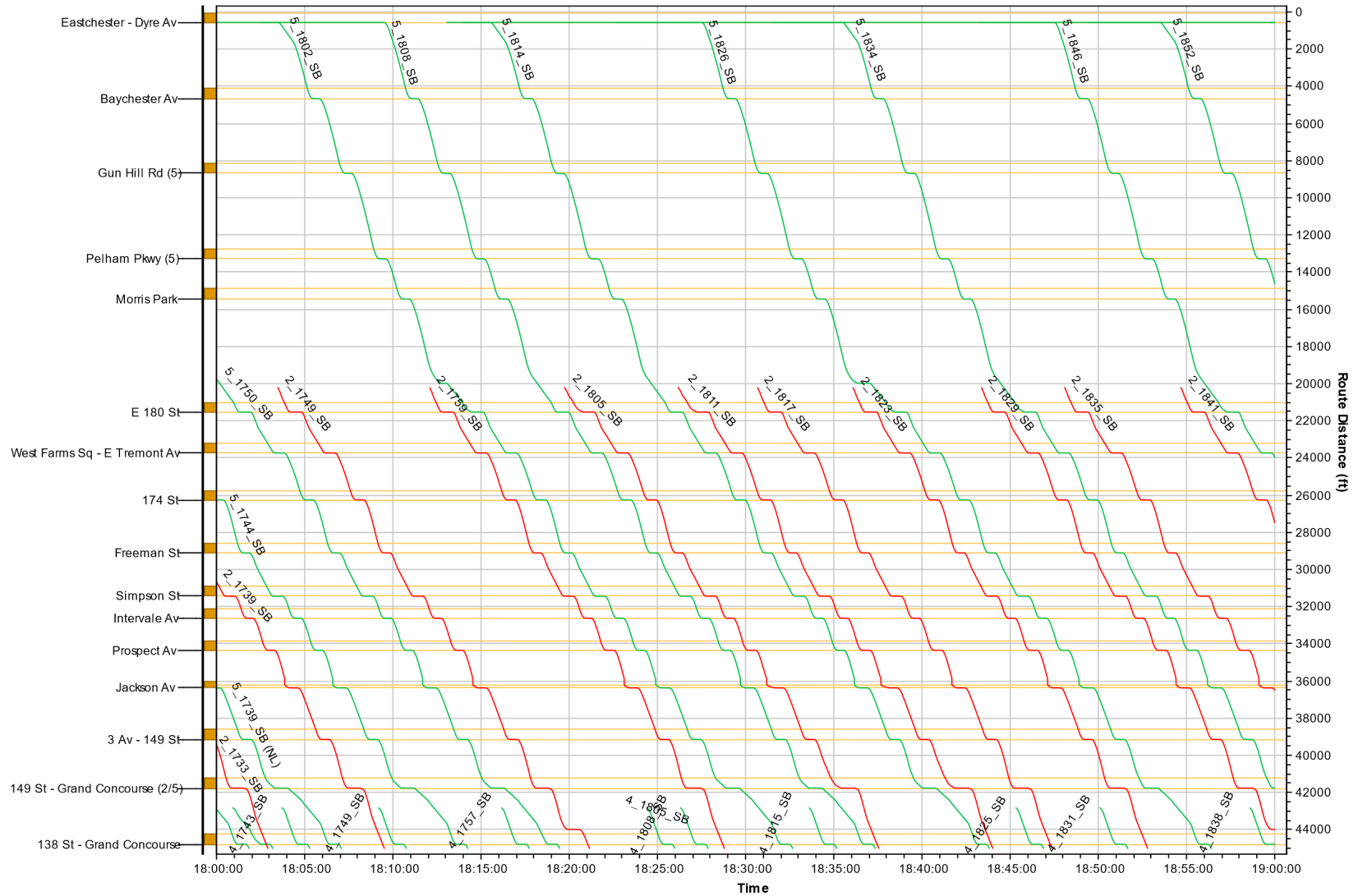
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-111: Future Baseline (CBTC) String Chart – Eastchester-Dyre Avenue to 138 Street-Grand Concourse – Southbound – 5:00 to 6:00 p.m.



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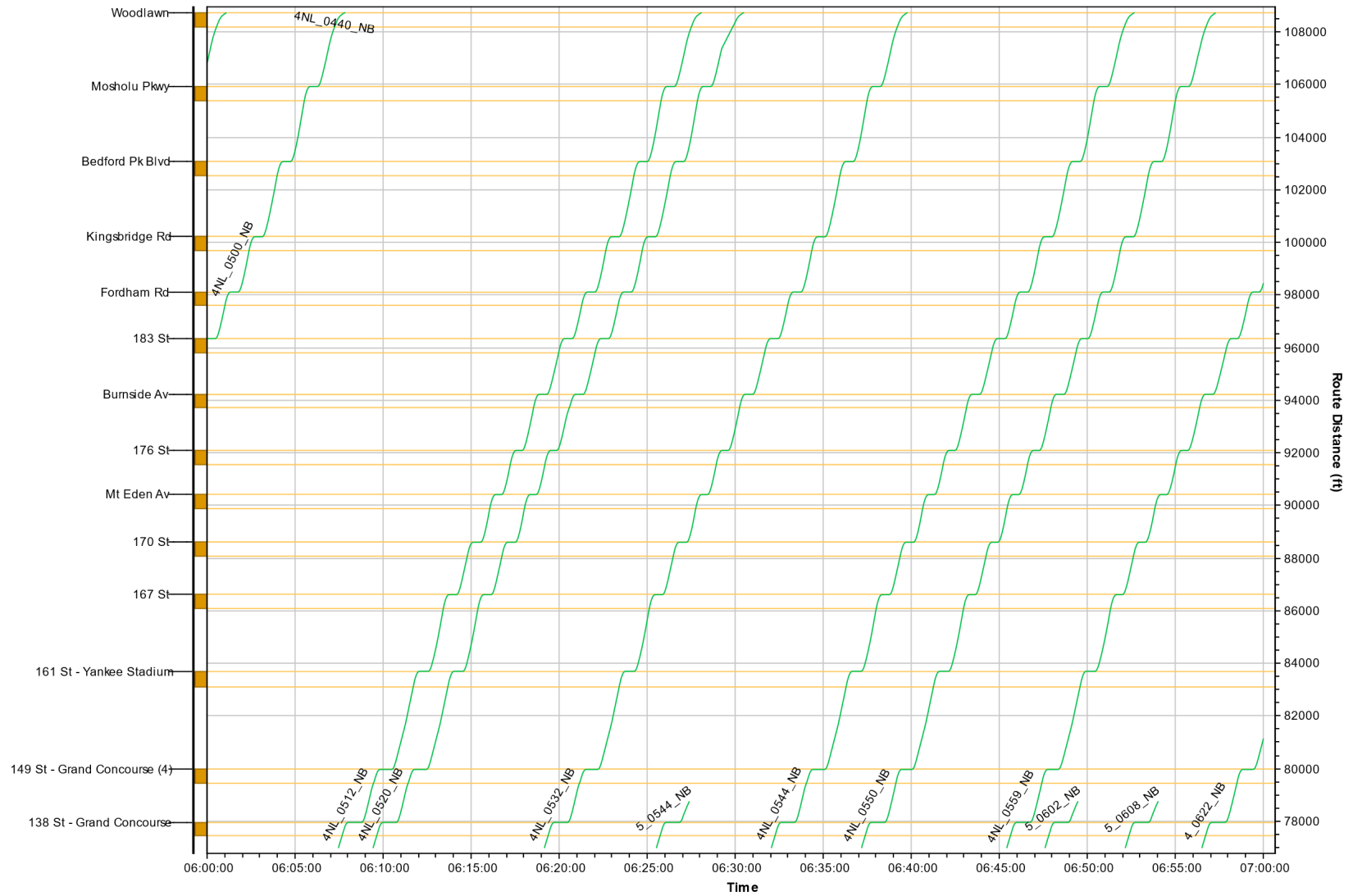
Figure G.4-112: Future Baseline (CBTC) String Chart – Eastchester-Dyre Avenue to 138 Street-Grand Concourse – Southbound – 6:00 to 7:00 p.m.



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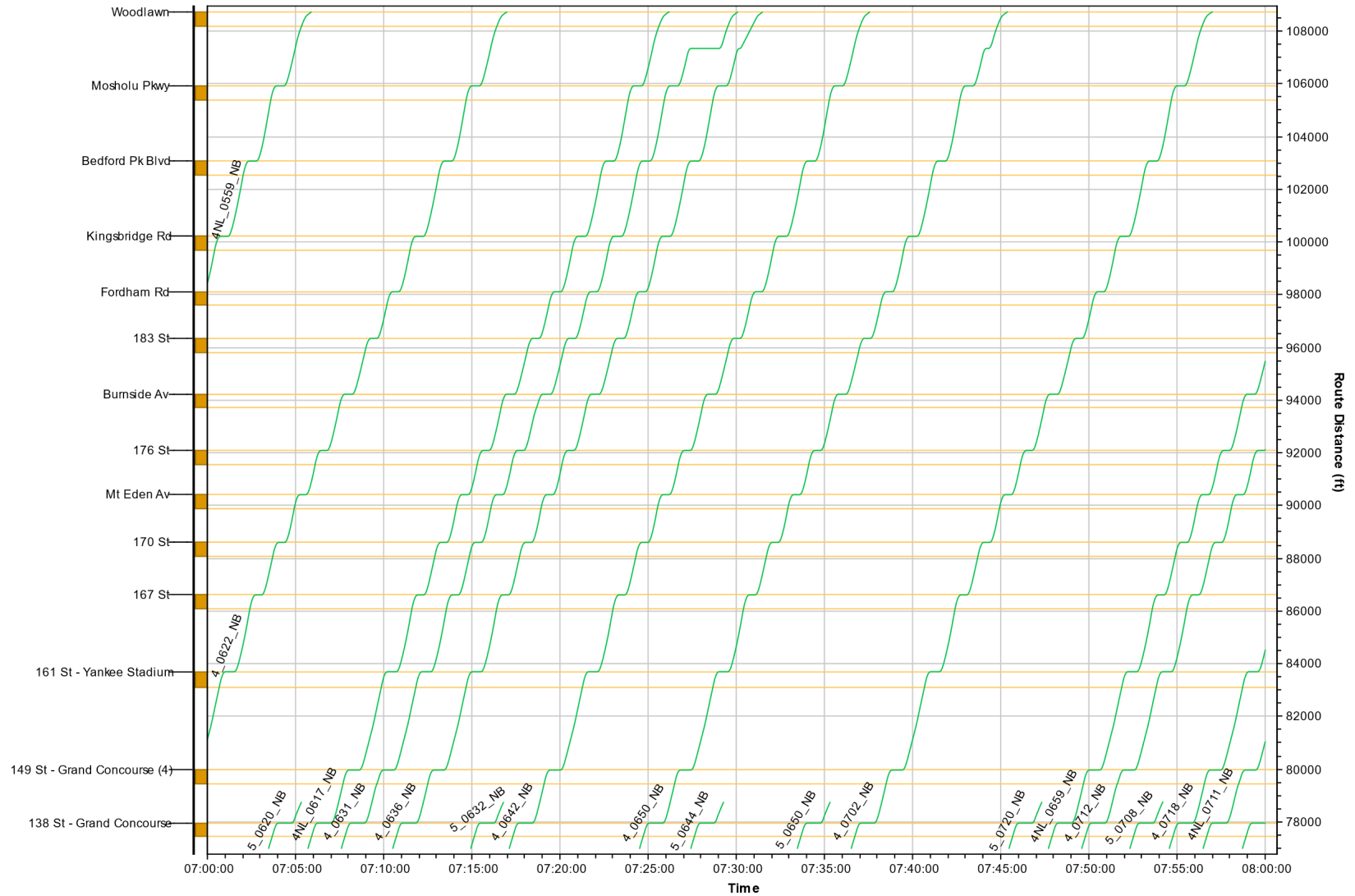
G.4.8 Woodlawn to 138 Street-Grand Concourse

Figure G.4-113: Future Baseline (CBTC) String Chart – 138 Street-Grand Concourse to Woodlawn – Northbound – 6:00 to 7:00 a.m.



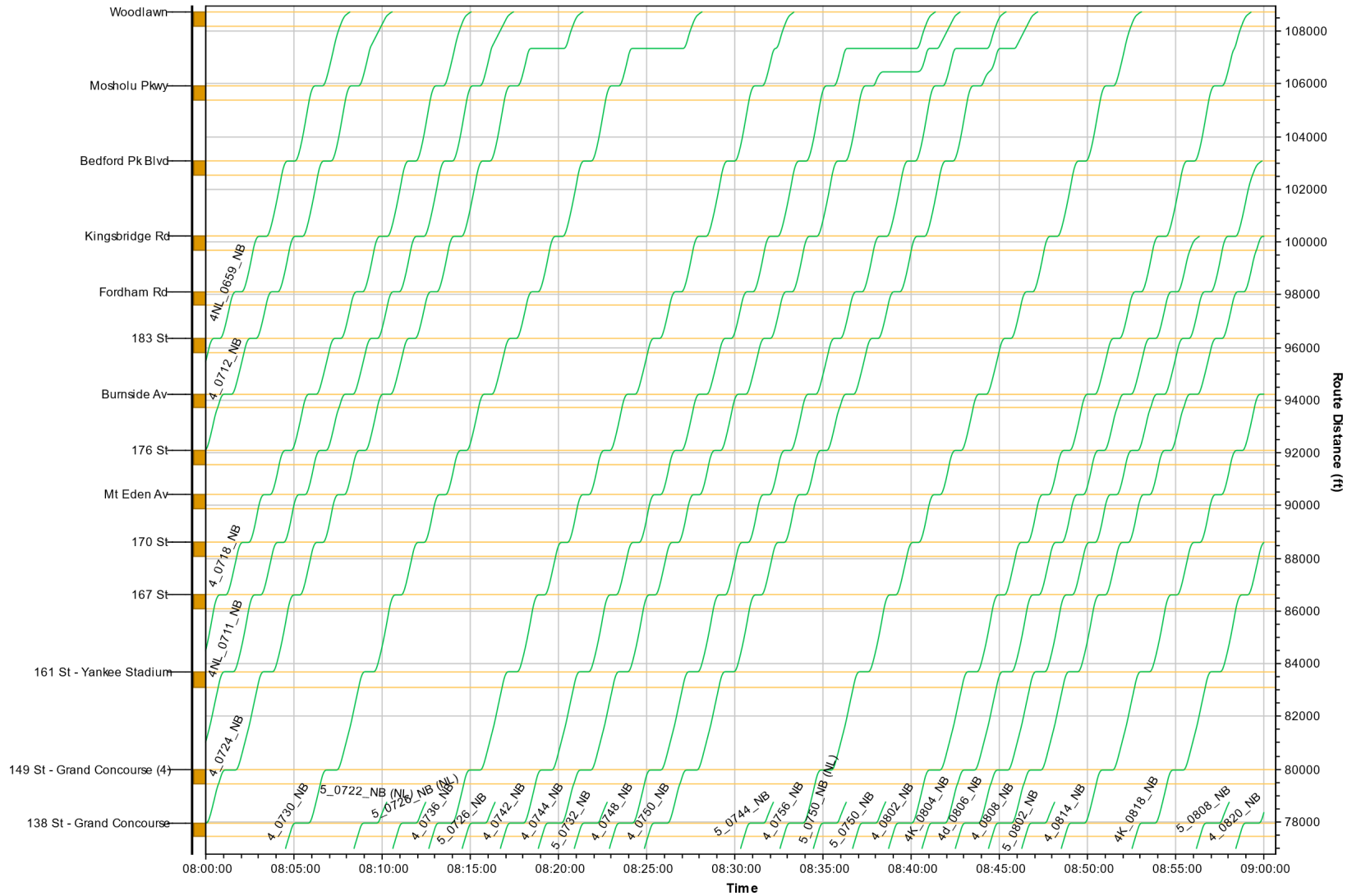
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Figure G.4-114: Future Baseline (CBTC) String Chart – 138 Street -Grand Concourse to Woodlawn – Northbound – 7:00 to 8:00 a.m.



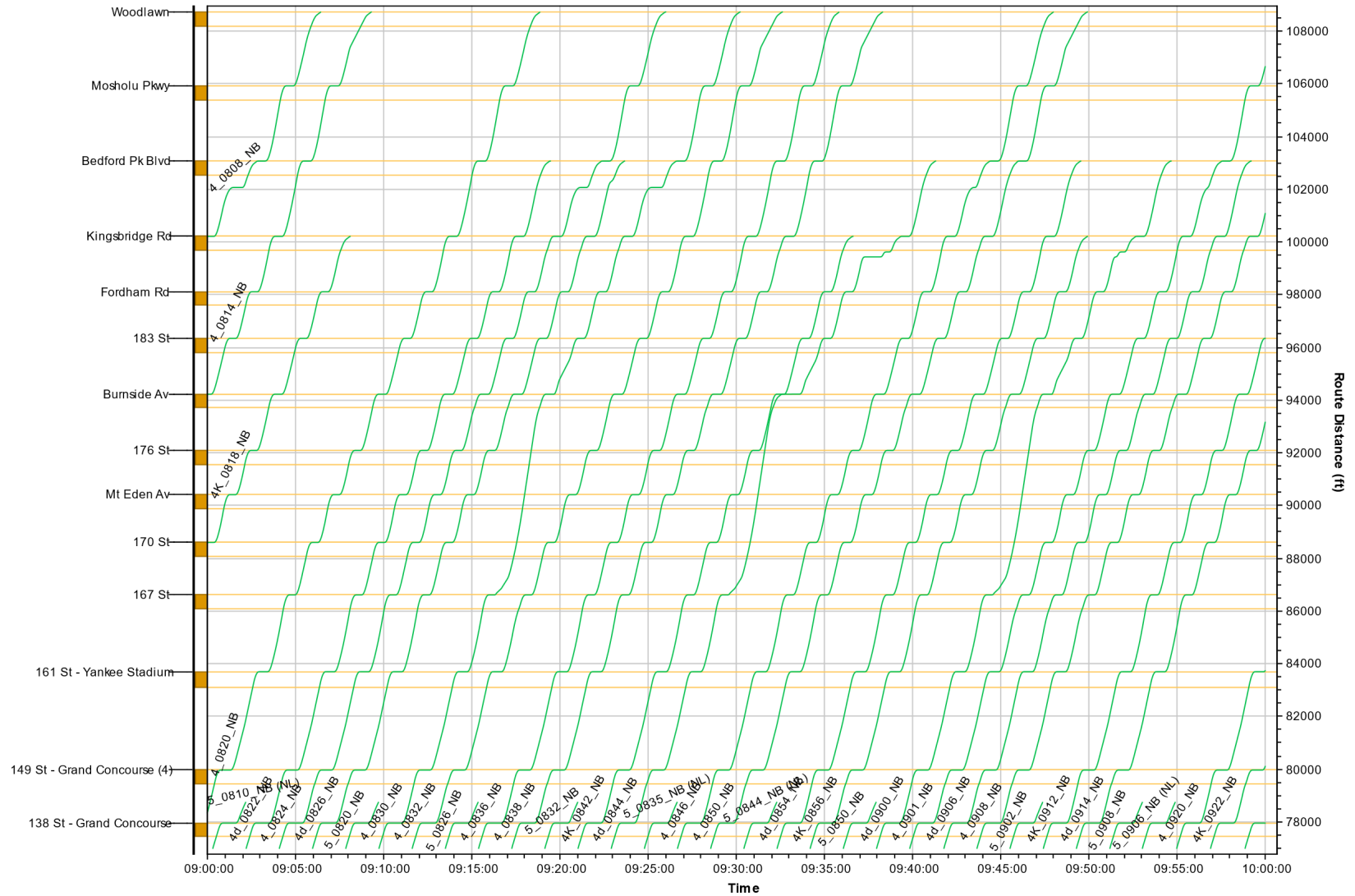
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-115: Future Baseline (CBTC) String Chart – 138 Street -Grand Concourse to Woodlawn – Northbound – 8:00 to 9:00 a.m.



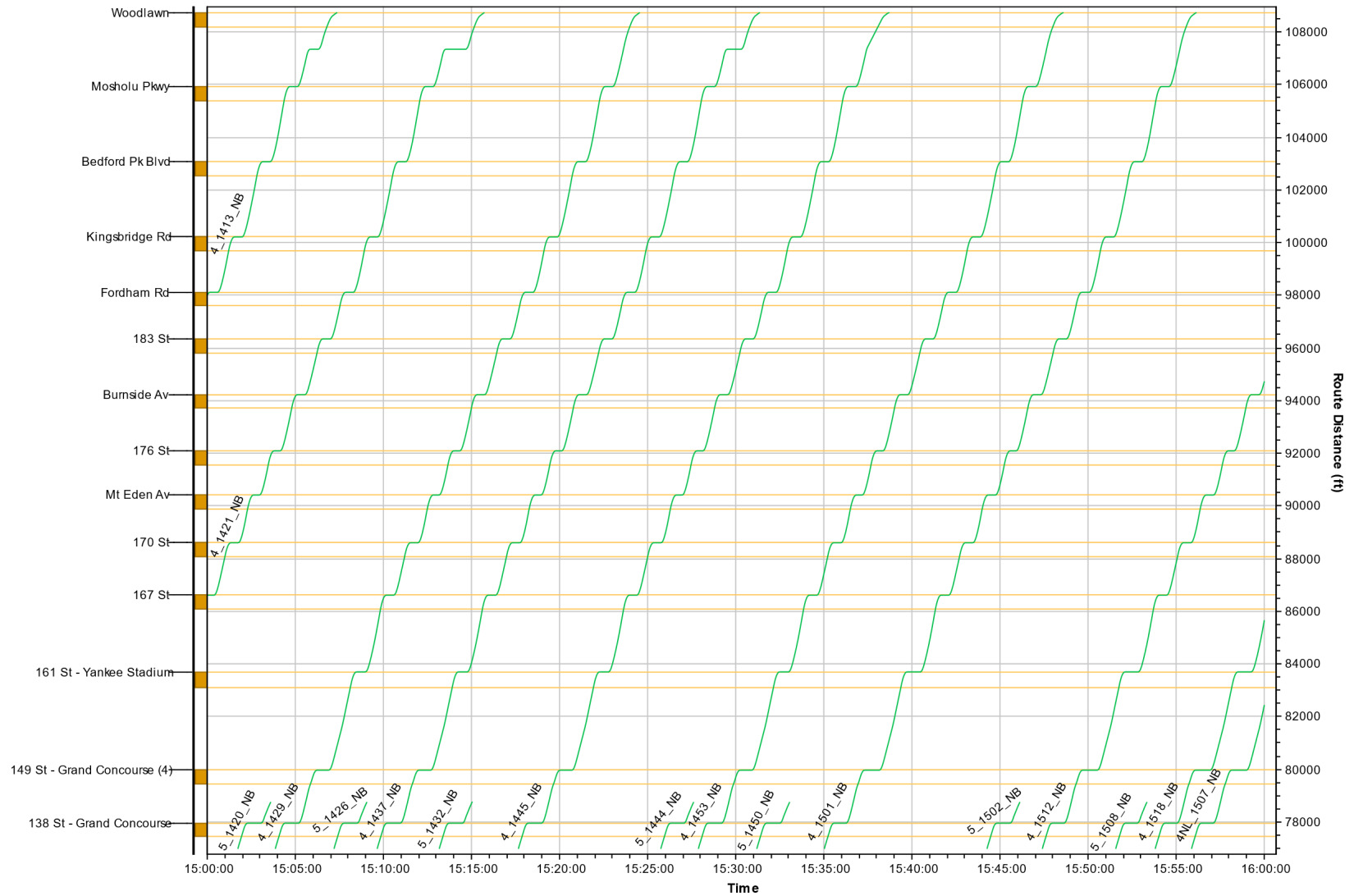
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-116: Future Baseline (CBTC) String Chart – 138 Street -Grand Concourse to Woodlawn – Northbound – 9:00 to 10:00 a.m.



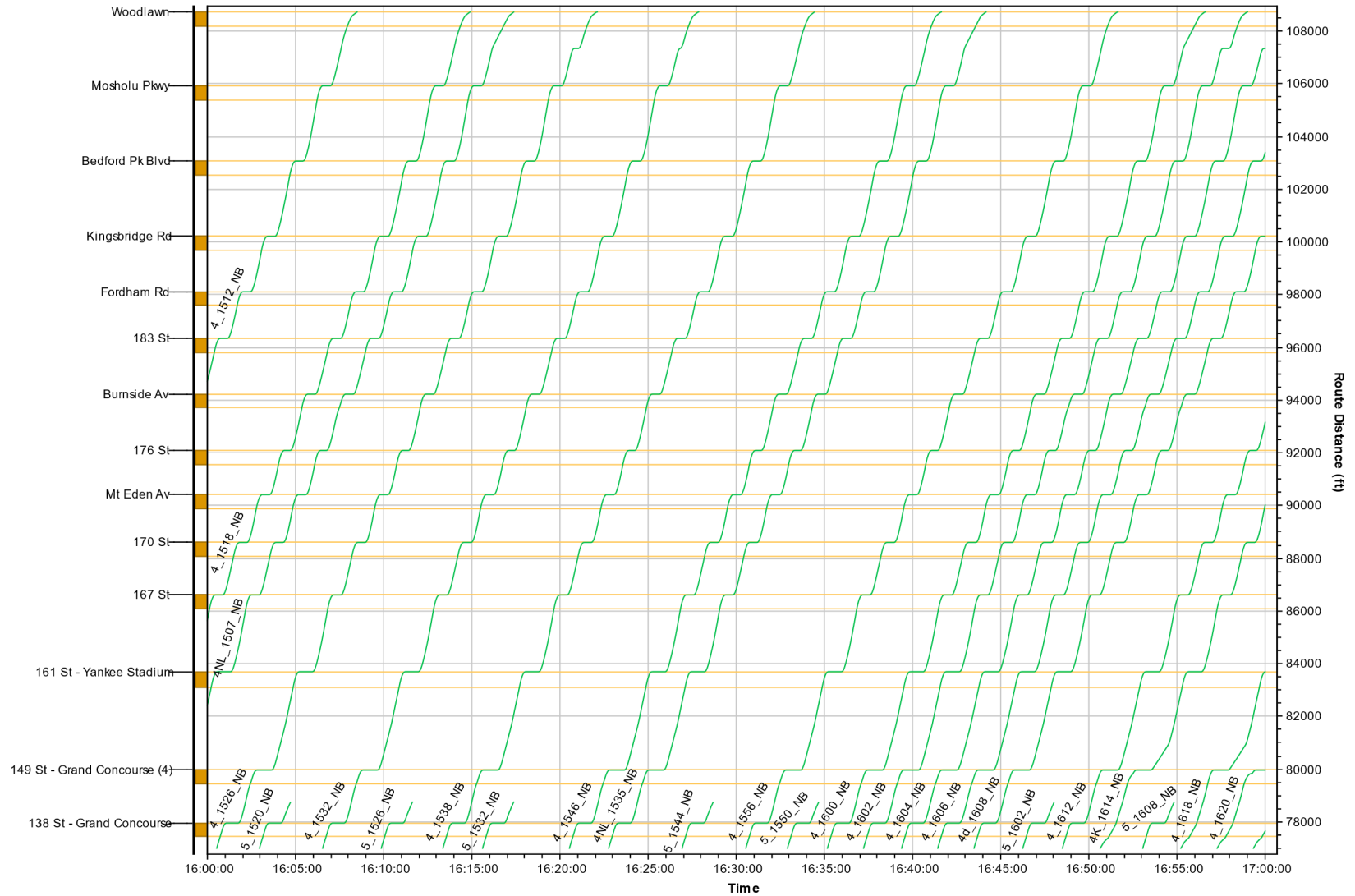
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Figure G.4-117: Future Baseline (CBTC) String Chart – 138 Street -Grand Concourse to Woodlawn – Northbound – 3:00 to 4:00 p.m.



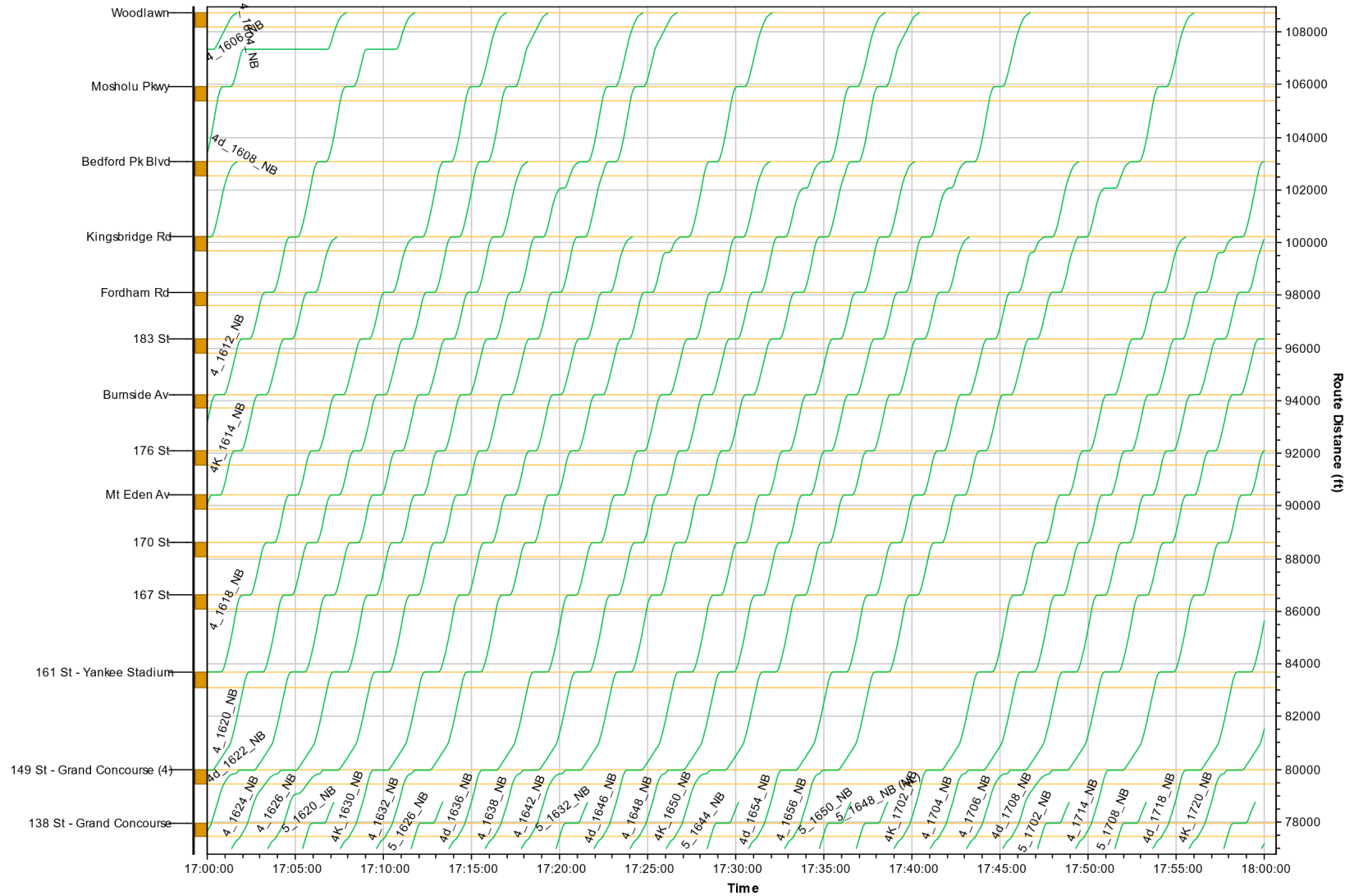
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-118: Future Baseline (CBTC) String Chart – 138 Street -Grand Concourse to Woodlawn – Northbound – 4:00 to 5:00 p.m.



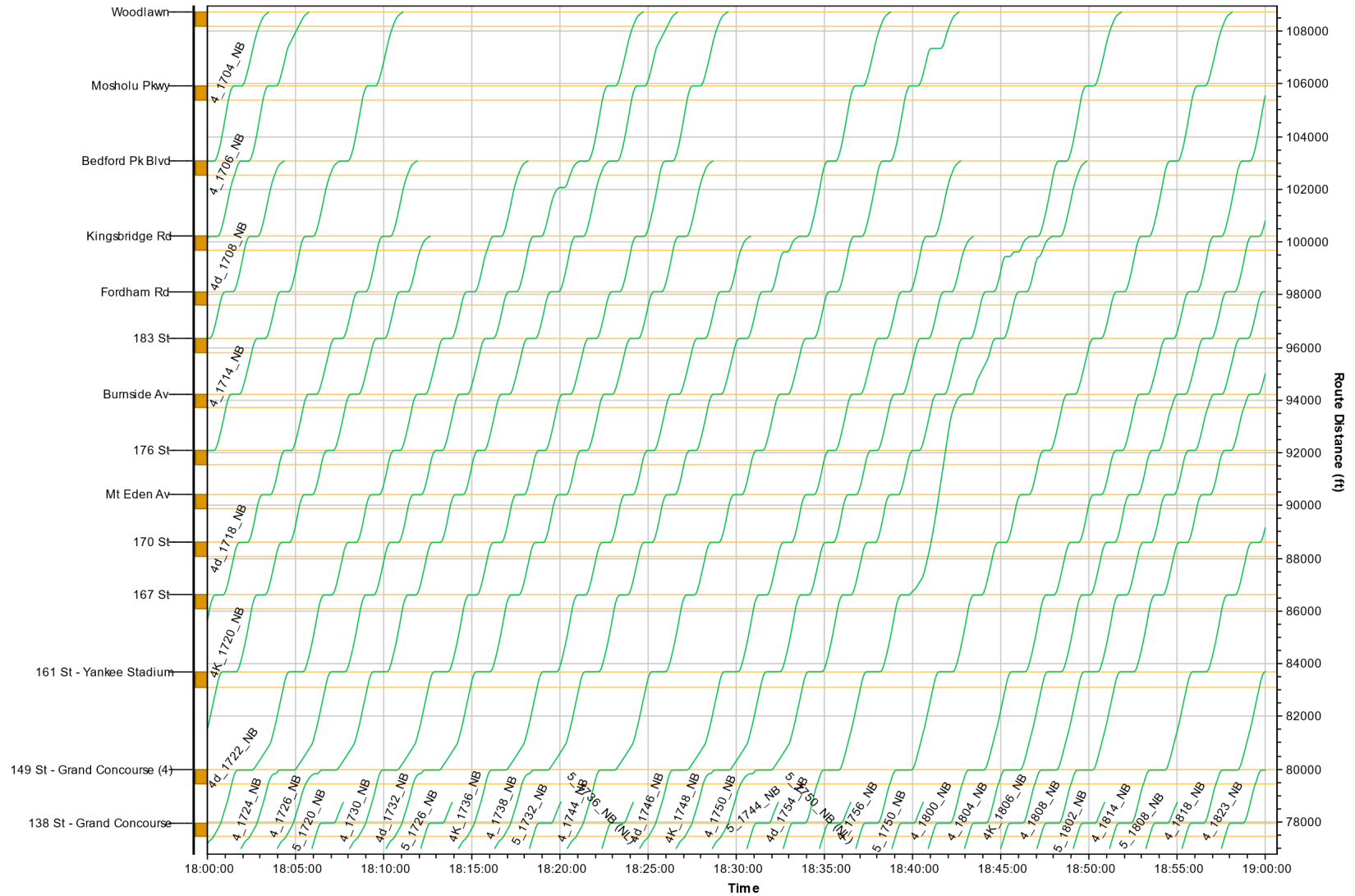
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-119: Future Baseline (CBTC) String Chart – 138 Street -Grand Concourse to Woodlawn – Northbound – 5:00 to 6:00 p.m.



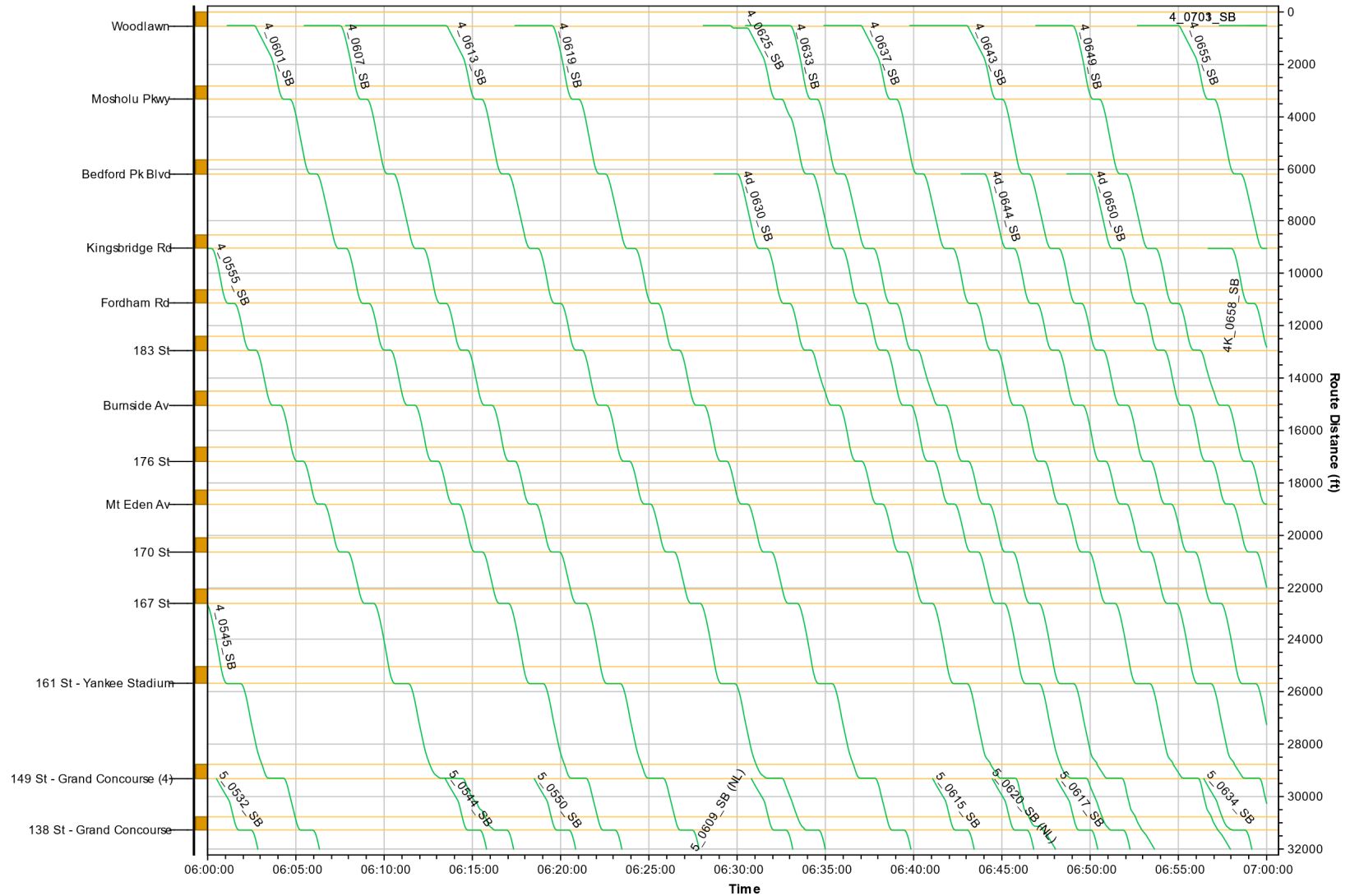
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-120: Future Baseline (CBTC) String Chart – 138 Street -Grand Concourse to Woodlawn – Northbound – 6:00 to 7:00 p.m.



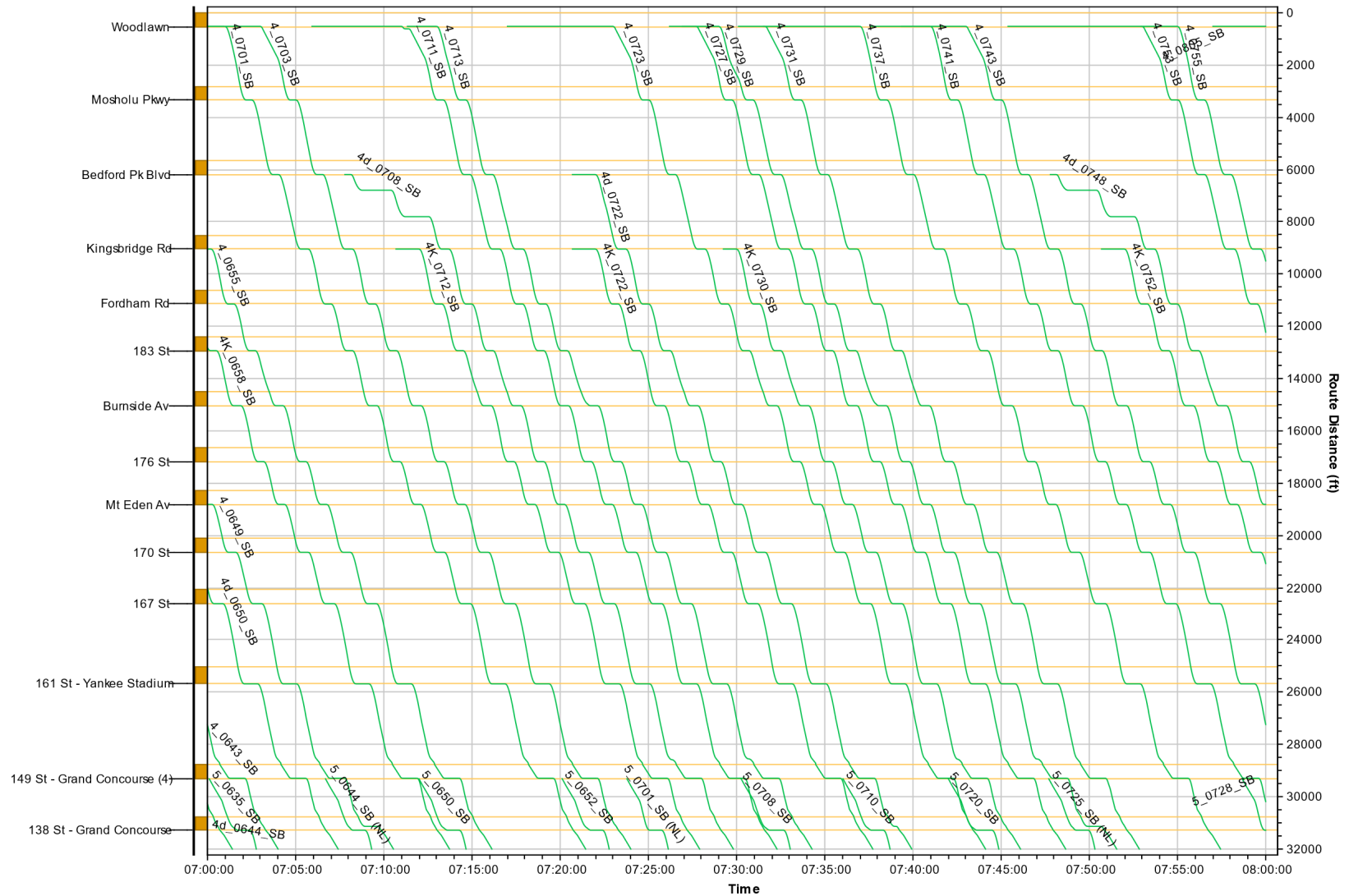
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-121: Future Baseline (CBTC) String Chart – Woodlawn to 138 Street -Grand Concourse – Southbound – 6:00 to 7:00 a.m.



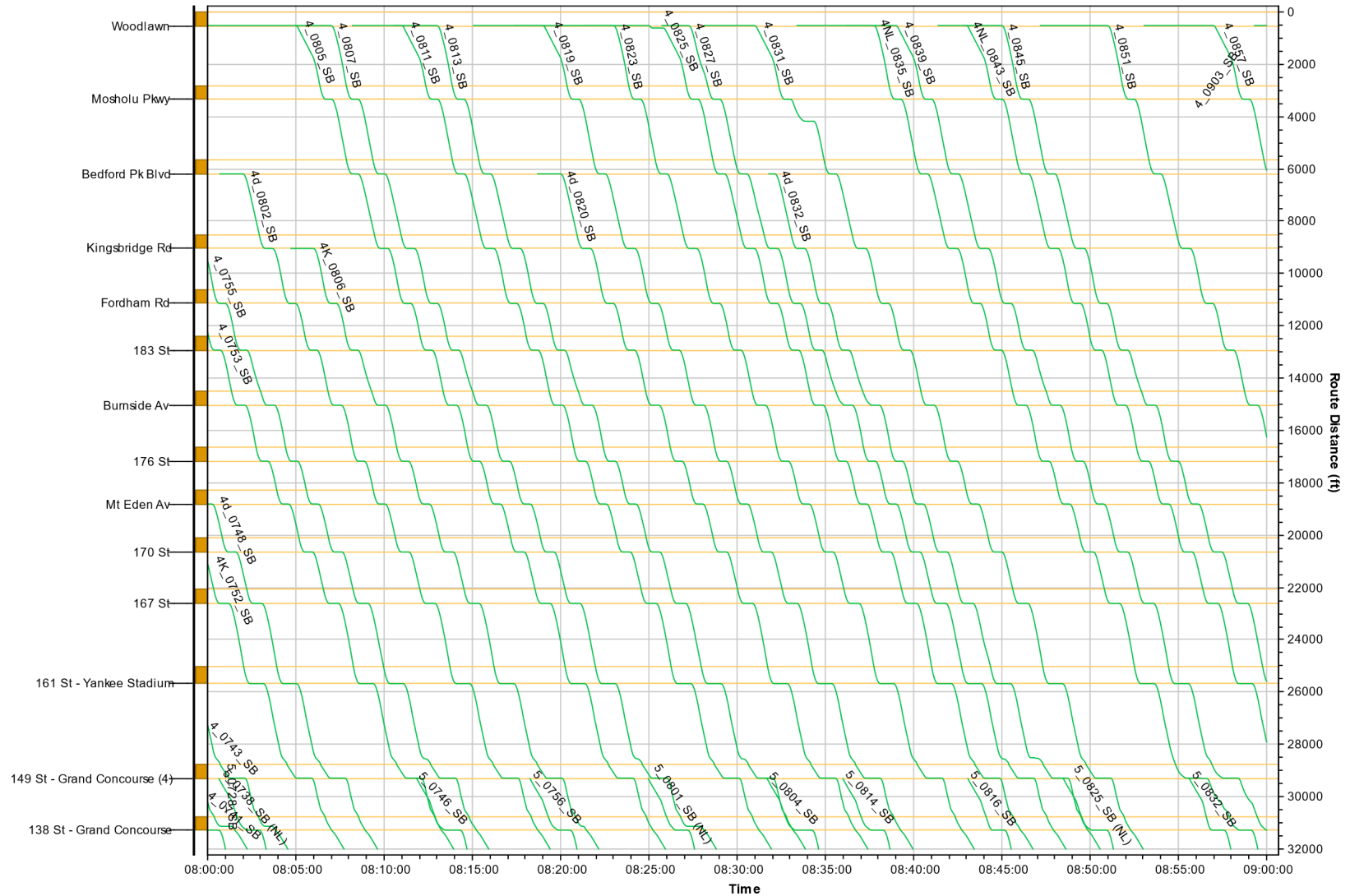
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-122: Future Baseline (CBTC) String Chart – Woodlawn to 138 Street -Grand Concourse – Southbound – 7:00 to 8:00 a.m.



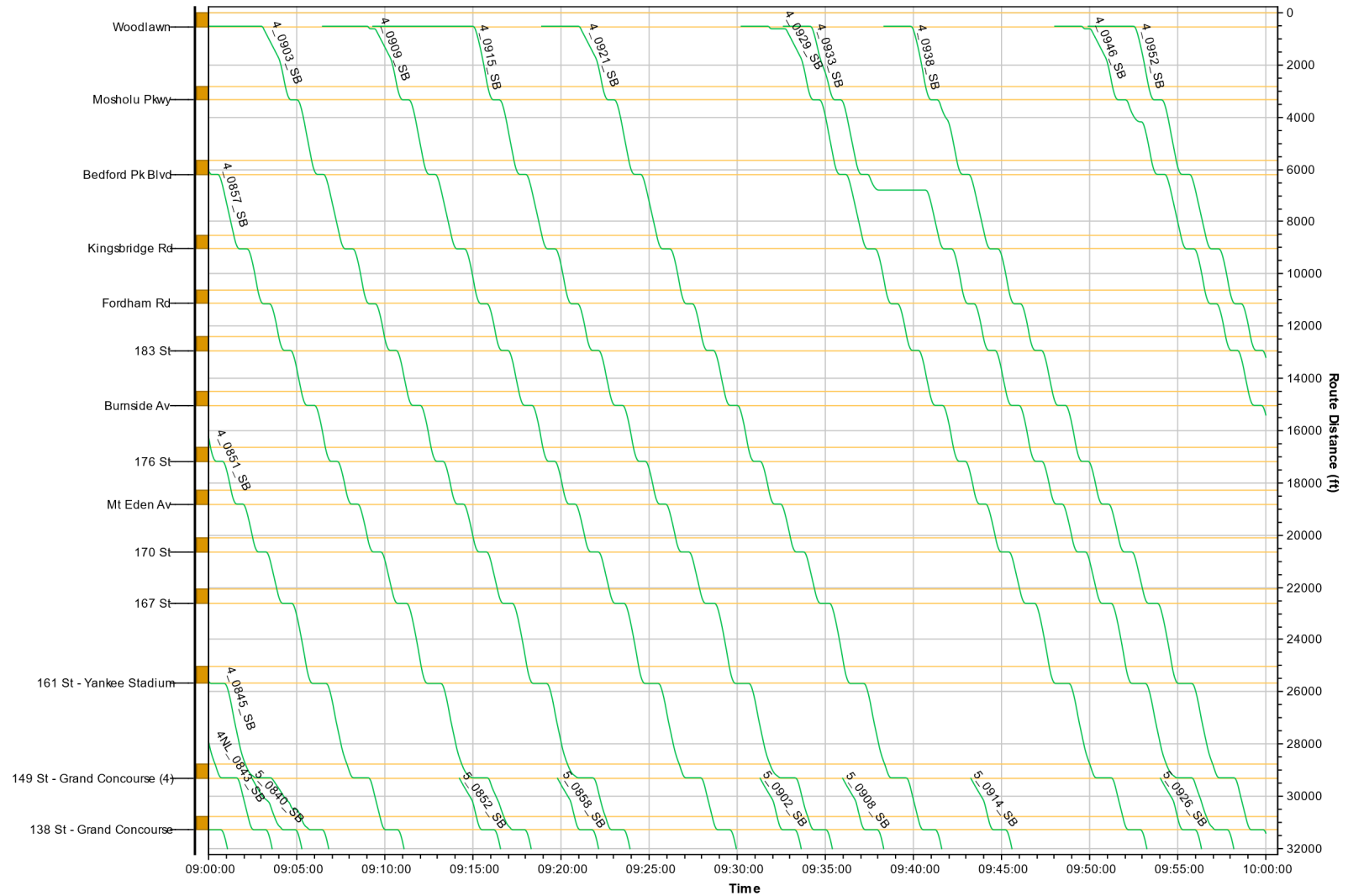
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-123: Future Baseline (CBTC) String Chart – Woodlawn to 138 Street -Grand Concourse – Southbound – 8:00 to 9:00 a.m.



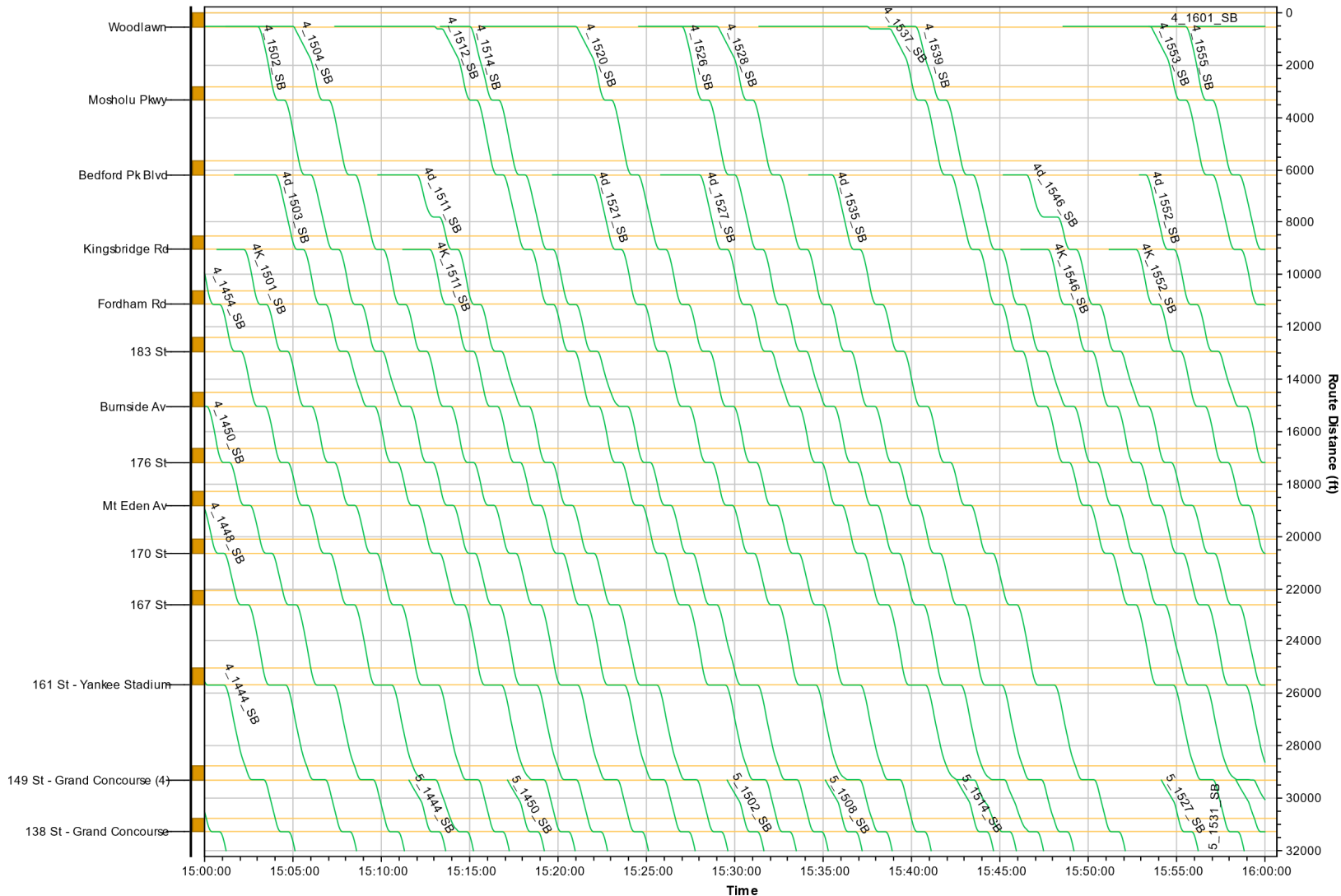
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-124: Future Baseline (CBTC) String Chart – Woodlawn to 138 Street -Grand Concourse – Southbound – 9:00 to 10:00 a.m.



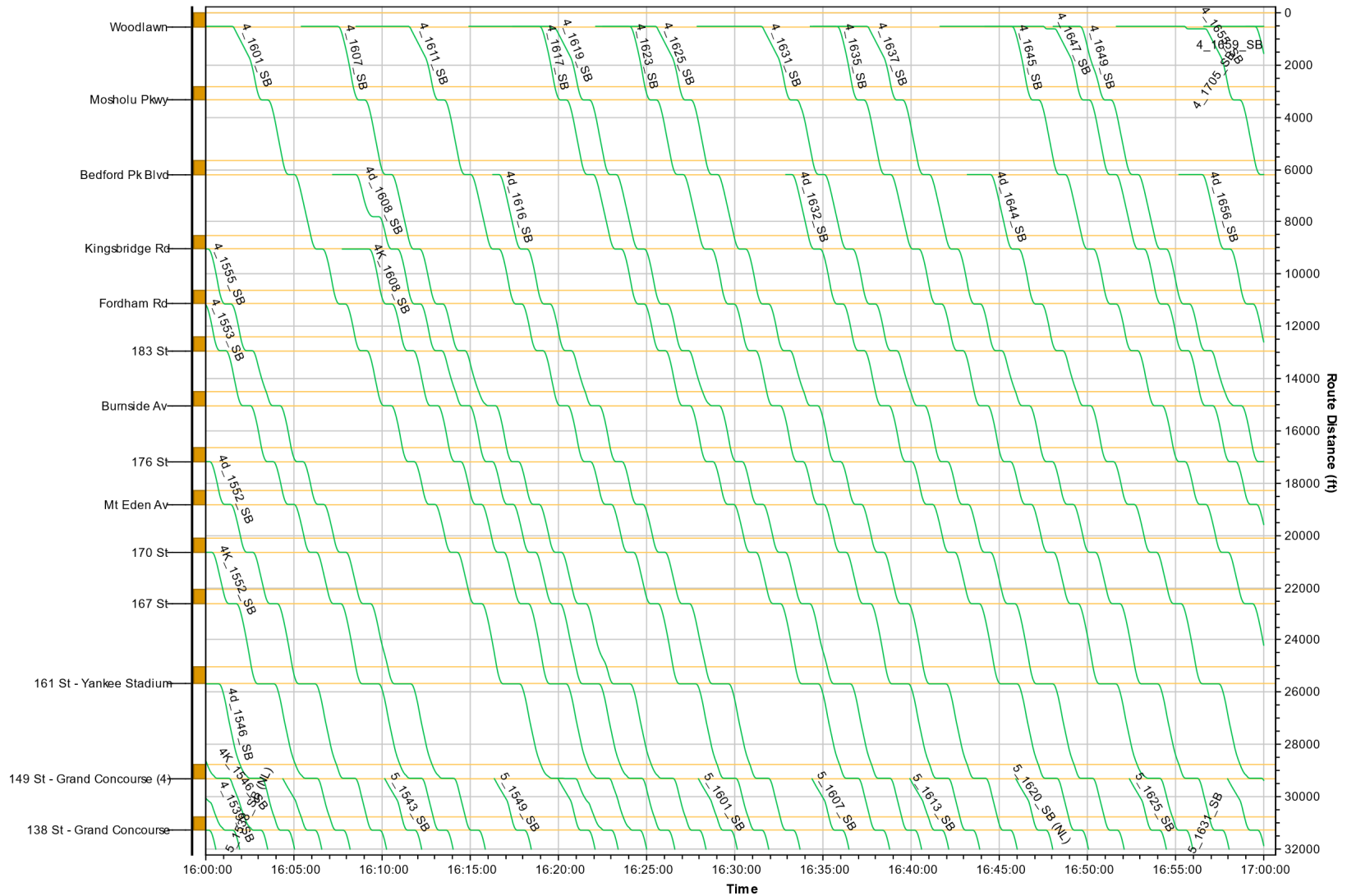
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-125: Future Baseline (CBTC) String Chart – Woodlawn to 138 Street -Grand Concourse – Southbound – 3:00 to 4:00 p.m.



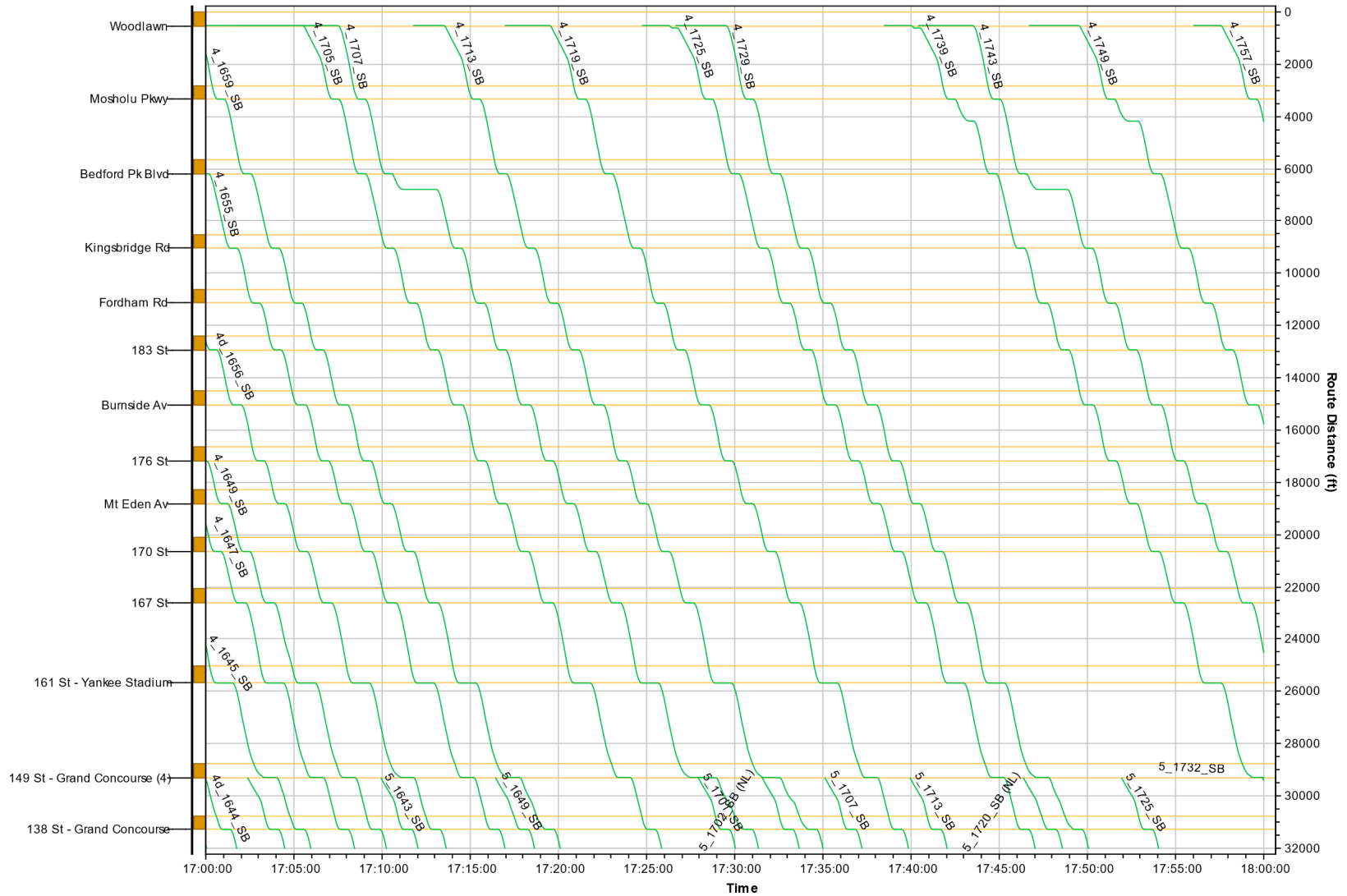
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-126: Future Baseline (CBTC) String Chart – Woodlawn to 138 Street -Grand Concourse – Southbound – 4:00 to 5:00 p.m.



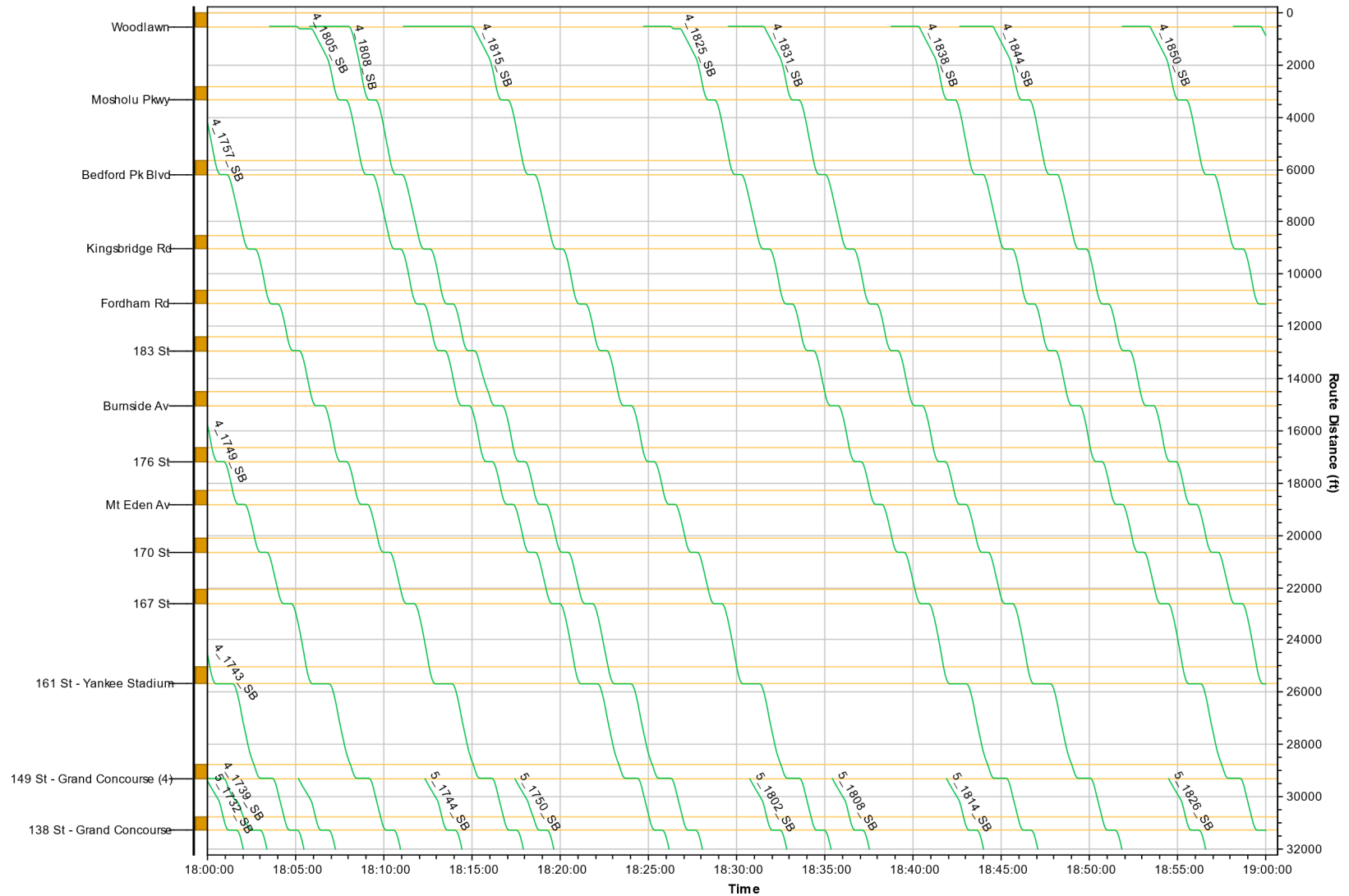
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-127: Future Baseline (CBTC) String Chart – Woodlawn to 138 Street -Grand Concourse – Southbound – 5:00 to 6:00 p.m.



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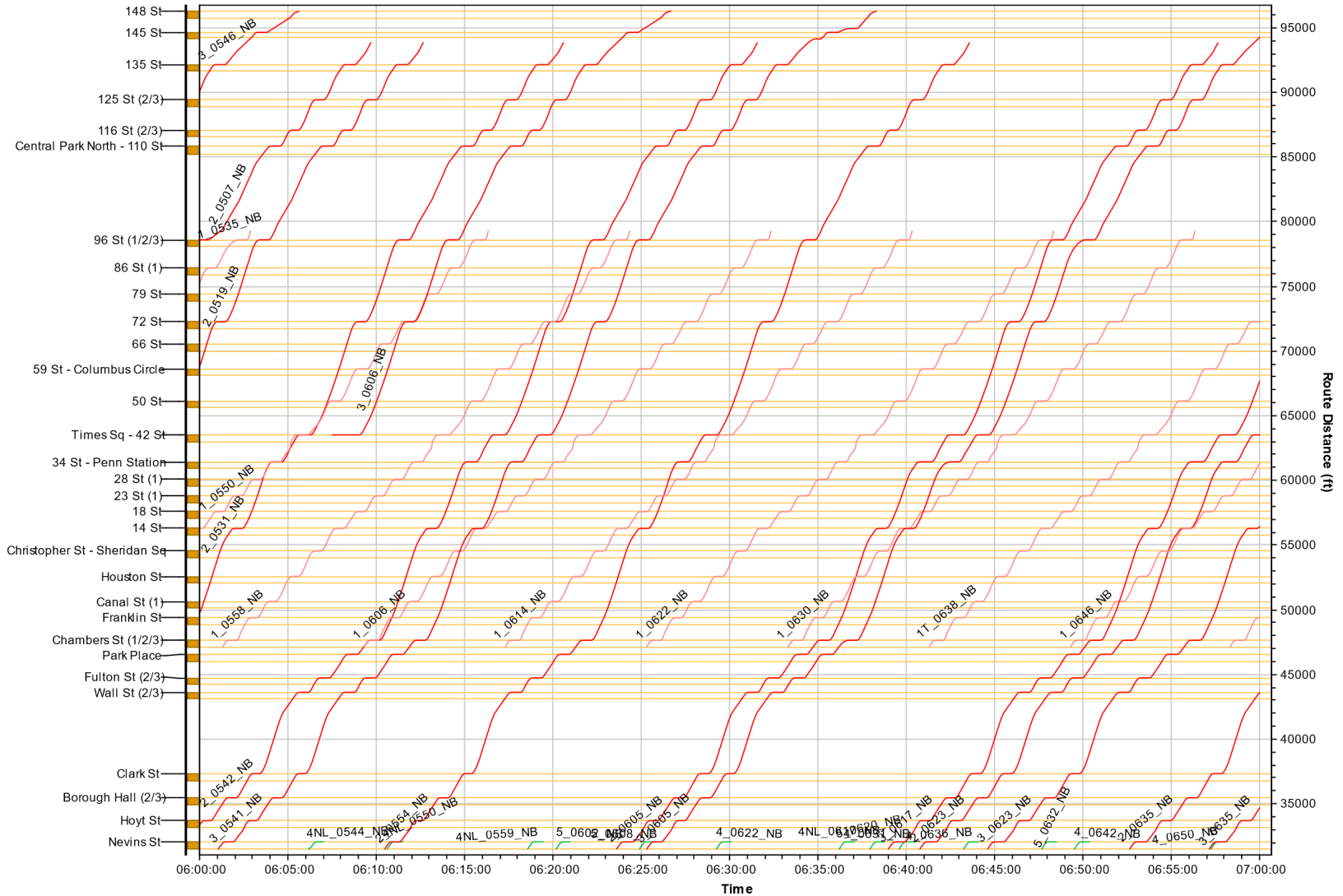
Figure G.4-128: Future Baseline (CBTC) String Chart – Woodlawn to 138 Street -Grand Concourse – Southbound – 6:00 to 7:00 p.m.



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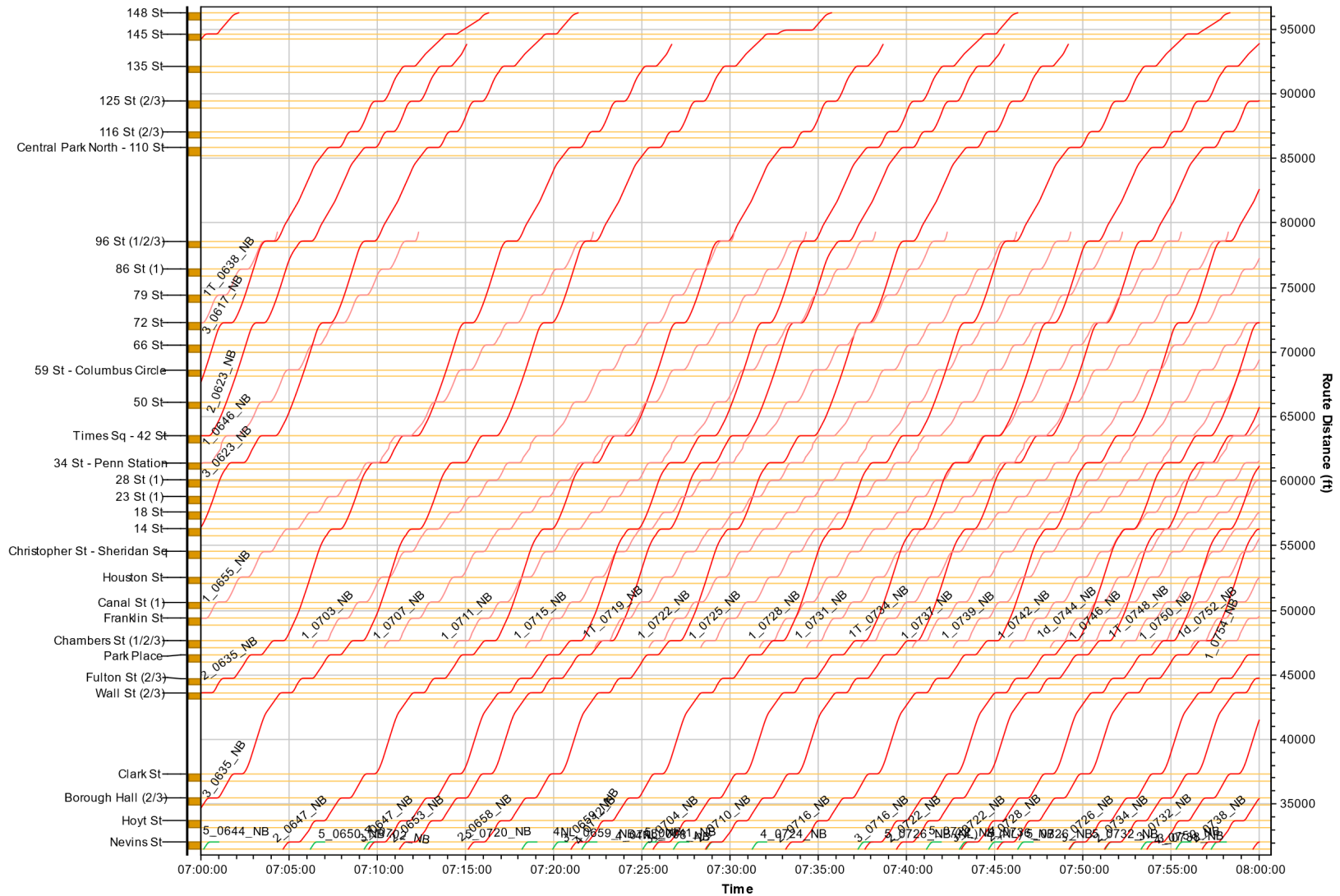
G.4.9 Harlem-148 Street to Nevins Street

Figure G.4-129: Future Baseline (CBTC) String Chart – Nevins Street to Harlem-148 Street – Northbound – 6:00 to 7:00 a.m.



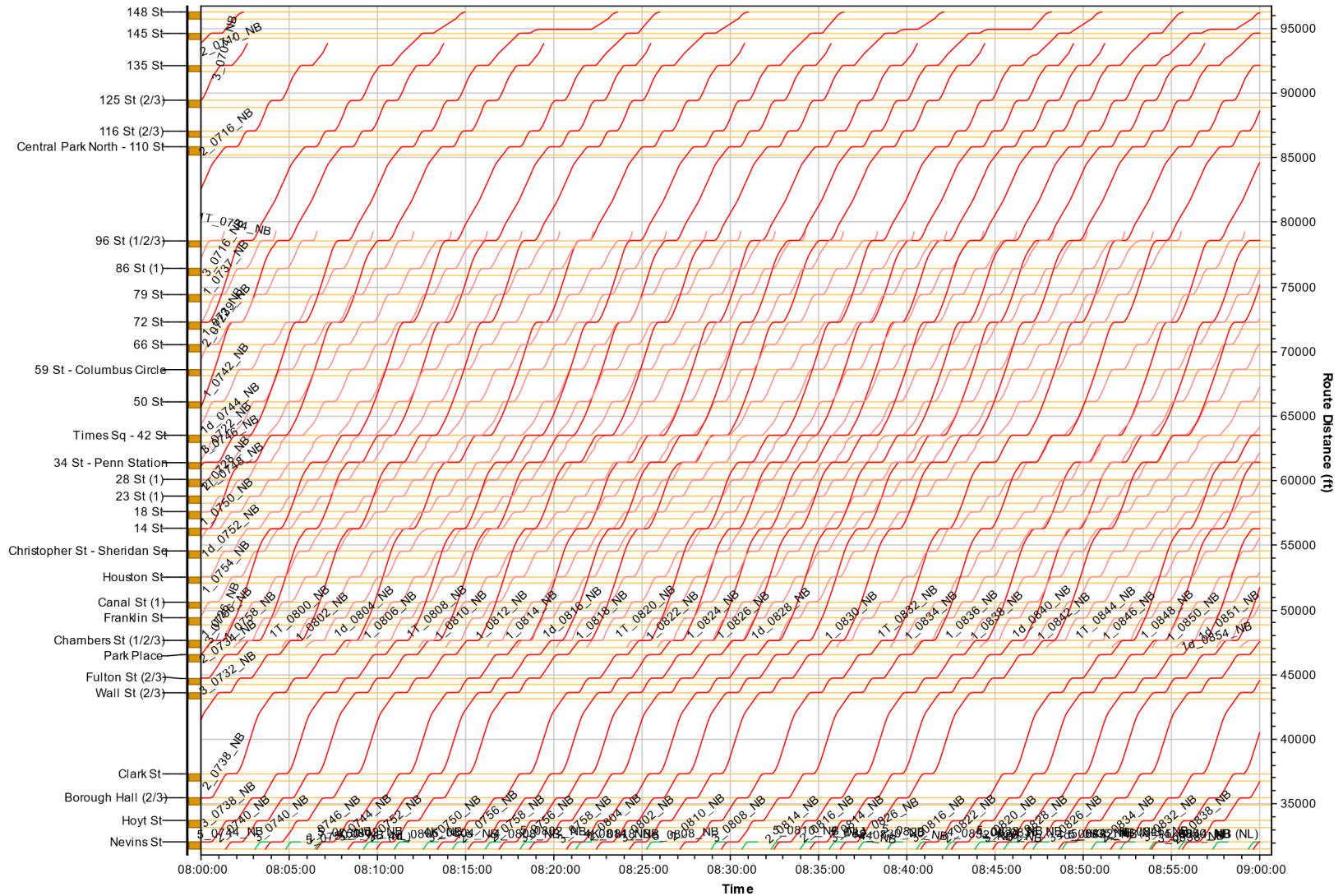
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-130: Future Baseline (CBTC) String Chart – Nevins Street to Harlem-148 Street – Northbound – 7:00 to 8:00 a.m.



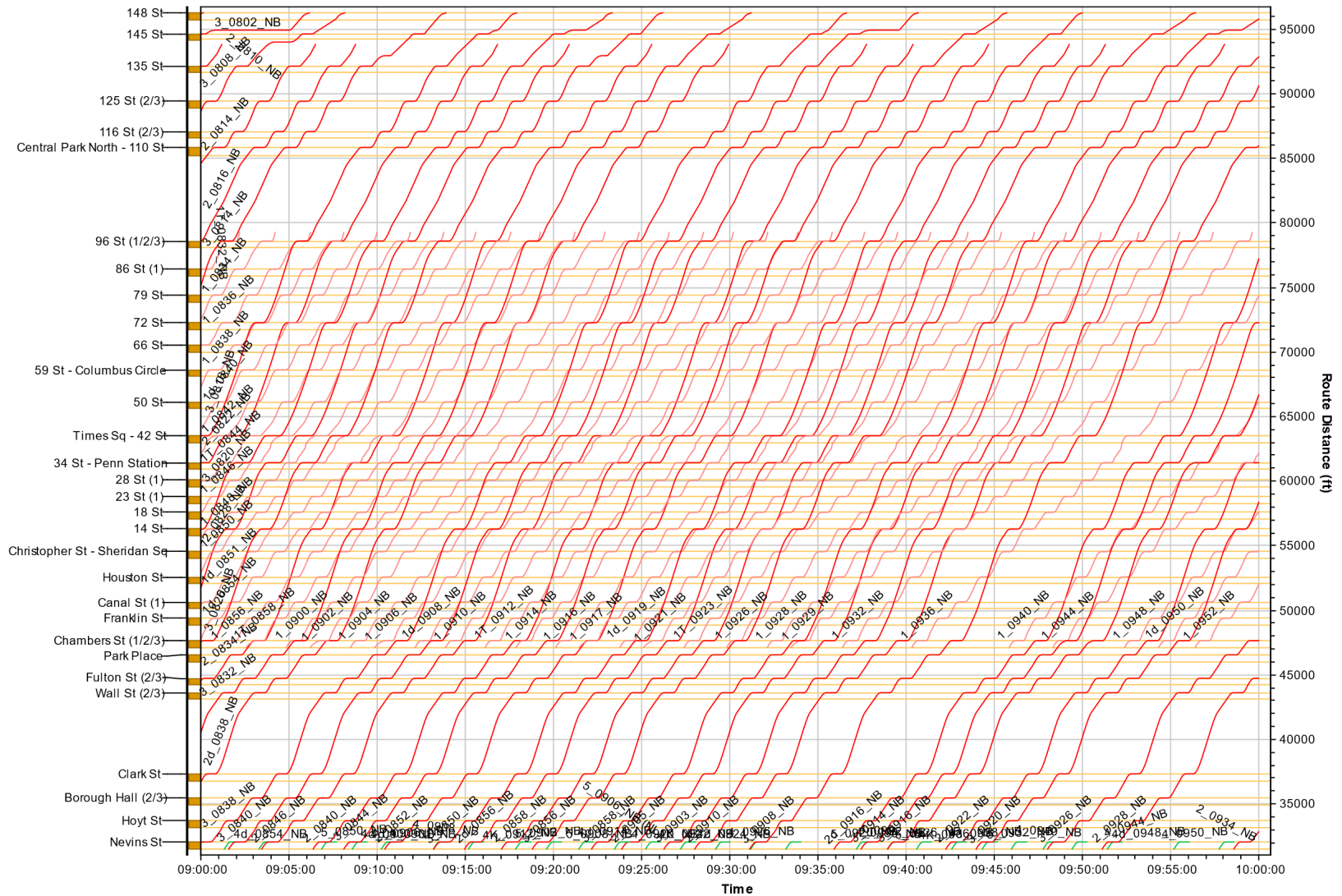
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-131: Future Baseline (CBTC) String Chart – Nevins Street to Harlem-148 Street – Northbound – 8:00 to 9:00 a.m.



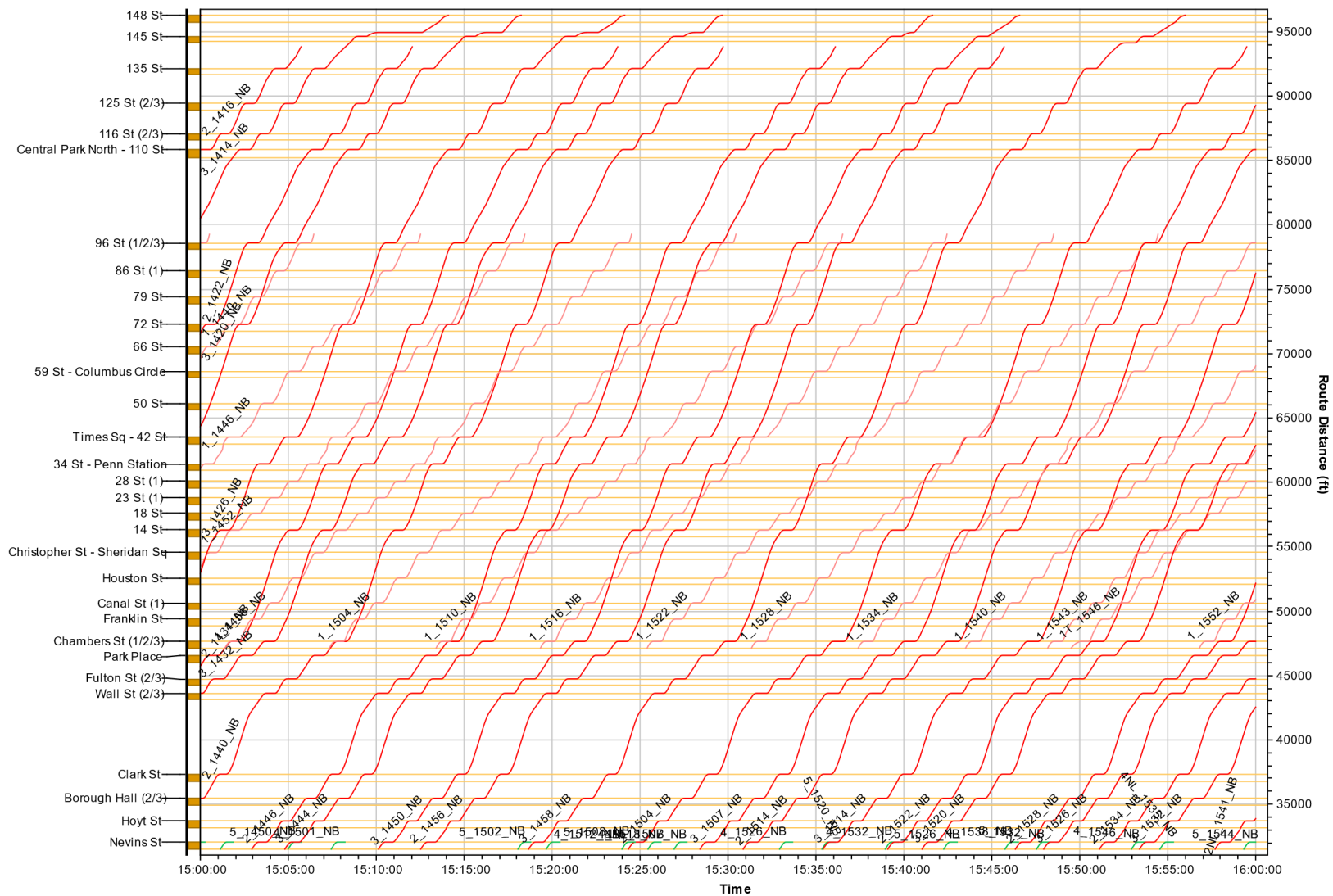
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-132: Future Baseline (CBTC) String Chart – Nevins Street to Harlem-148 Street – Northbound – 9:00 to 10:00 a.m.



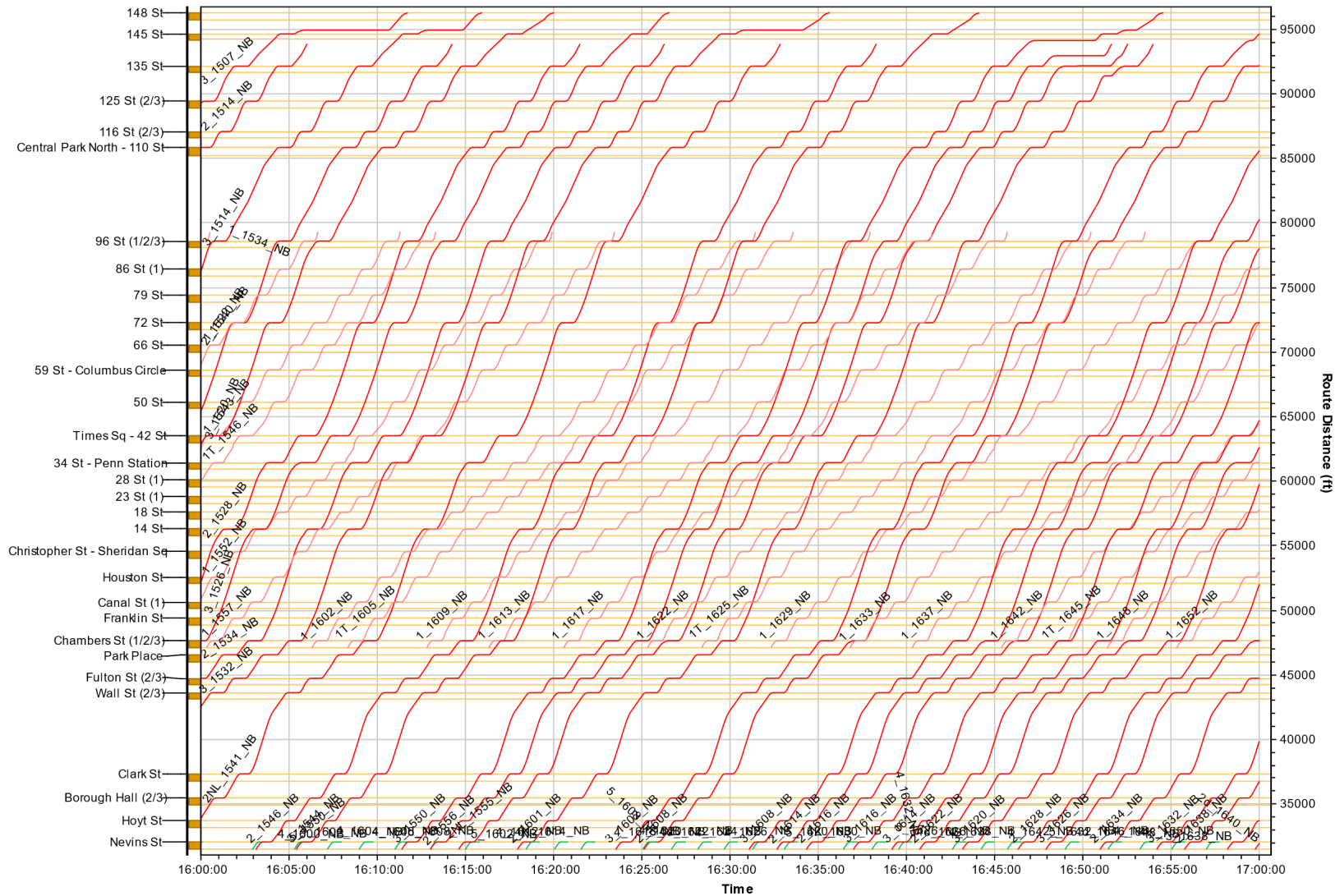
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-133: Future Baseline (CBTC) String Chart – Nevins Street to Harlem-148 Street – Northbound – 3:00 to 4:00 p.m.



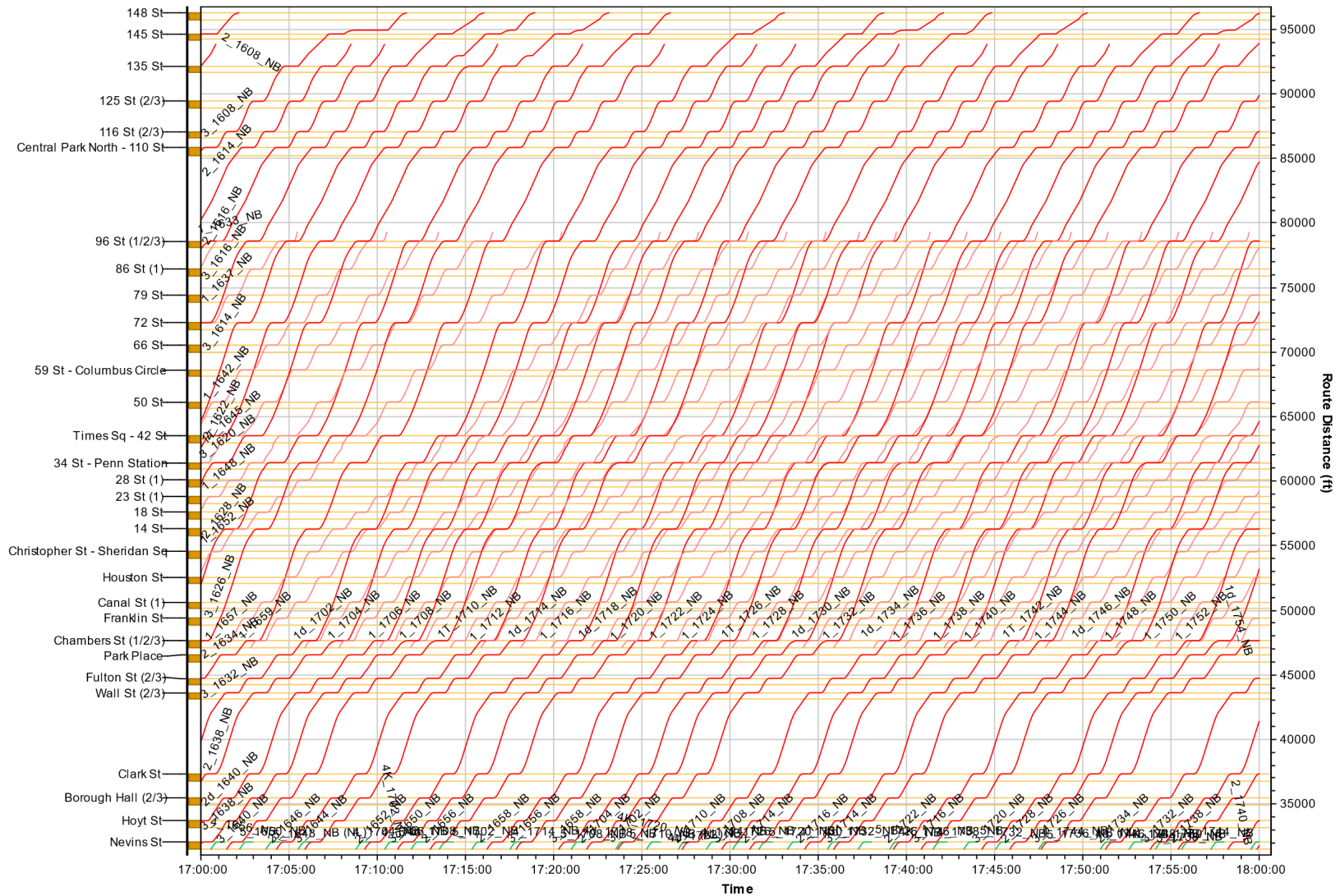
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-134: Future Baseline (CBTC) String Chart – Nevins Street to Harlem-148 Street – Northbound – 4:00 to 5:00 p.m.



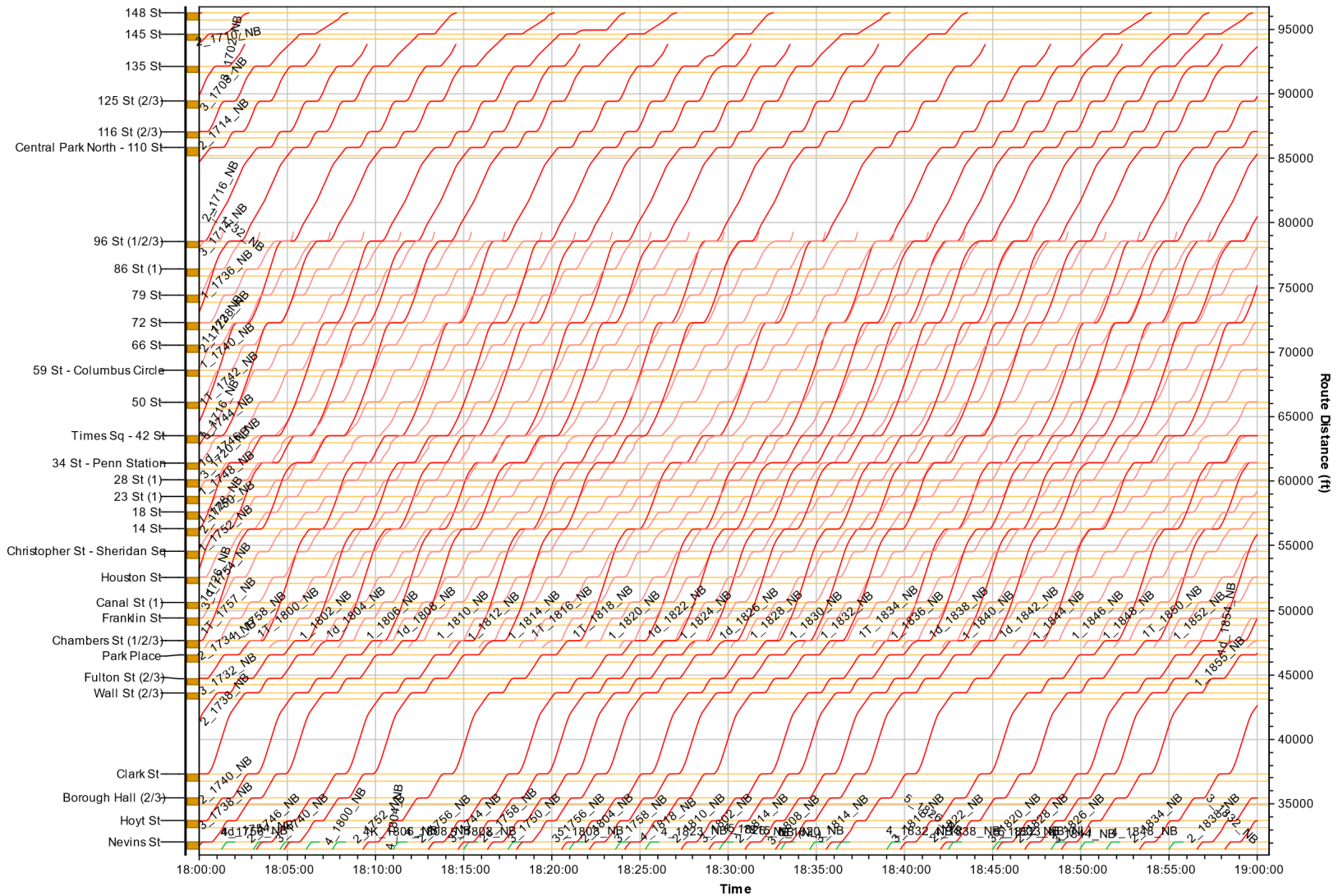
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-135: Future Baseline (CBTC) String Chart – Nevins Street to Harlem-148 Street – Northbound – 5:00 to 6:00 p.m.



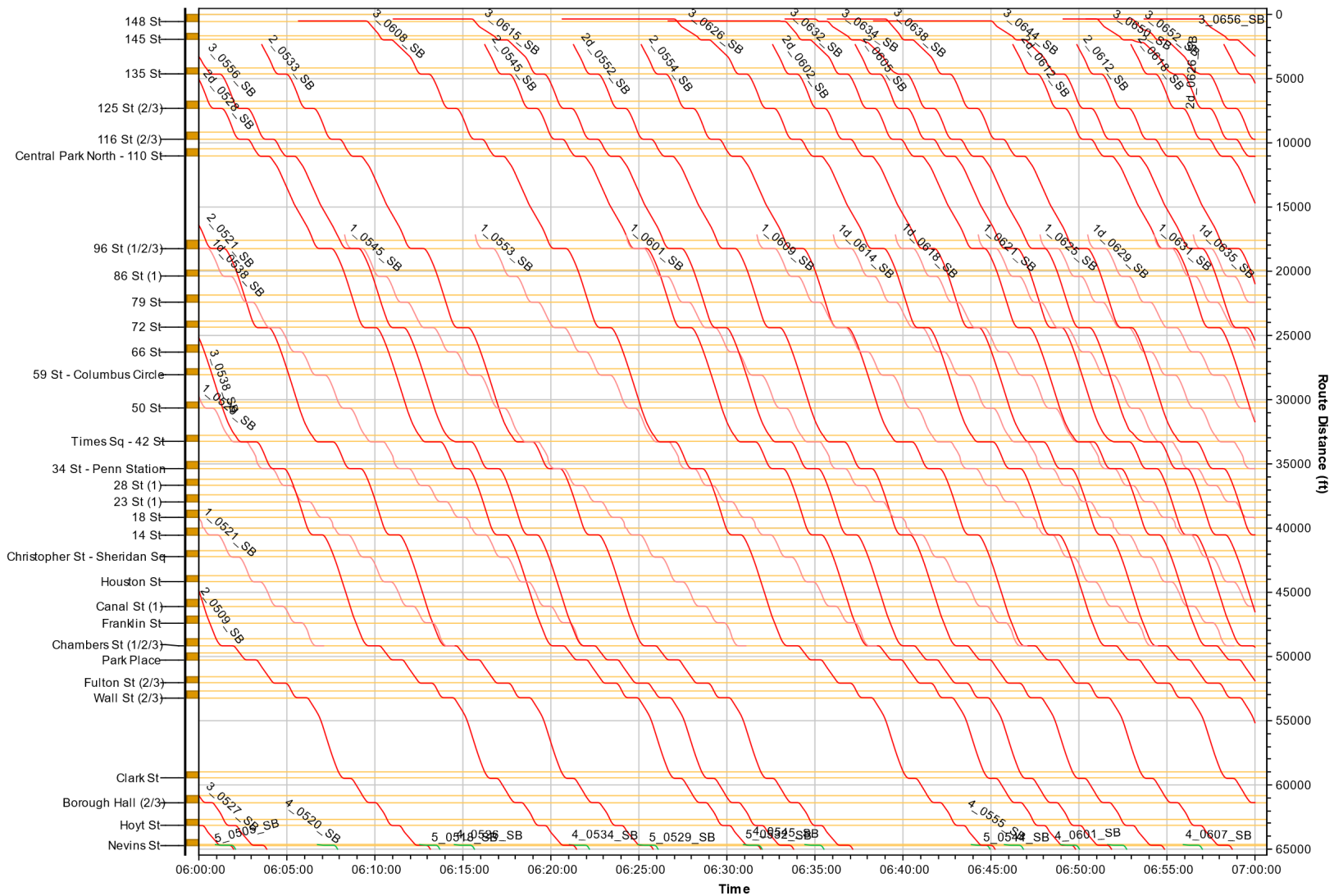
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-136: Future Baseline (CBTC) String Chart – Nevins Street to Harlem-148 Street – Northbound – 6:00 to 7:00 p.m.



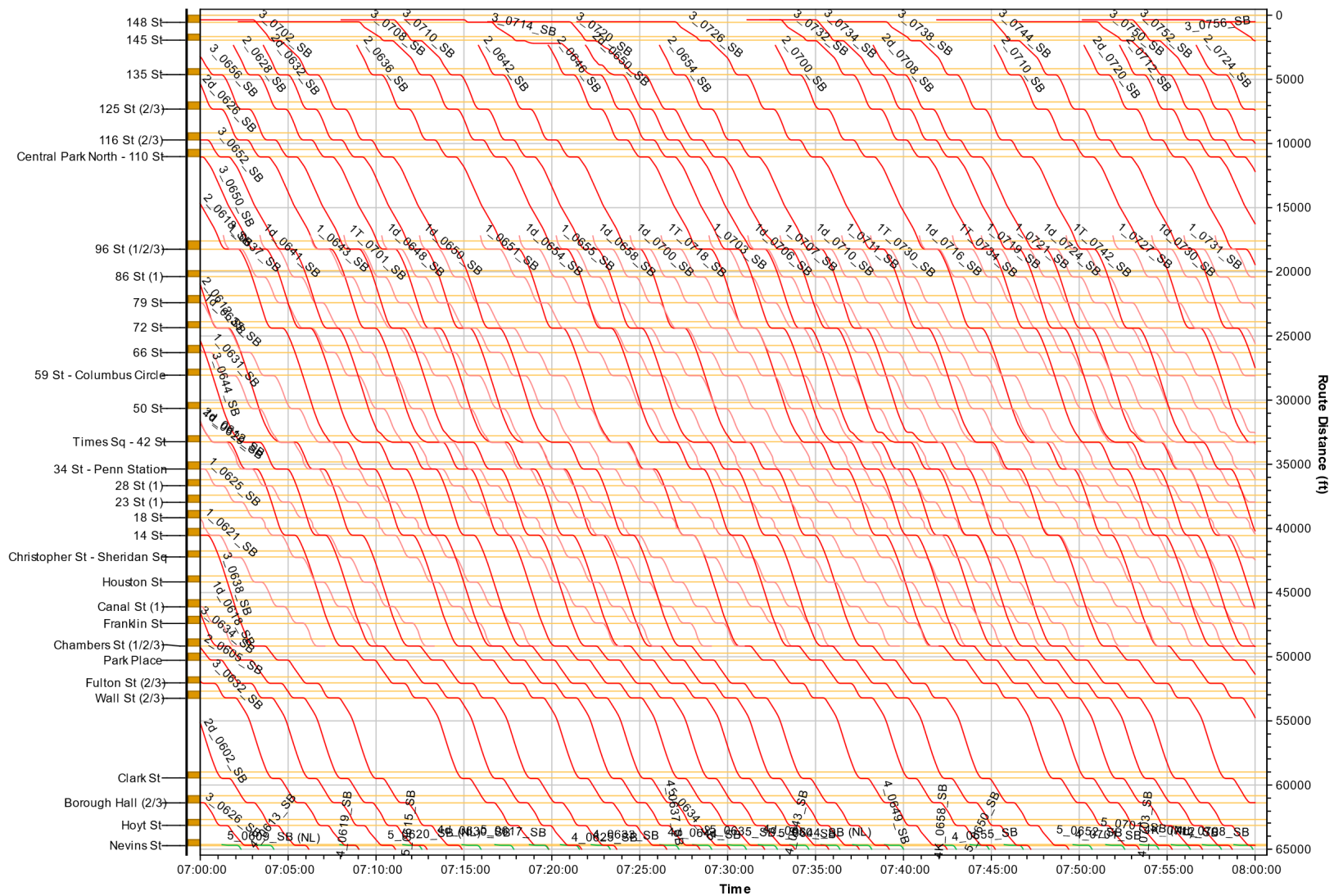
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-137: Future Baseline (CBTC) String Chart – Harlem-148 Street to Nevins Street – Southbound – 6:00 to 7:00 a.m.



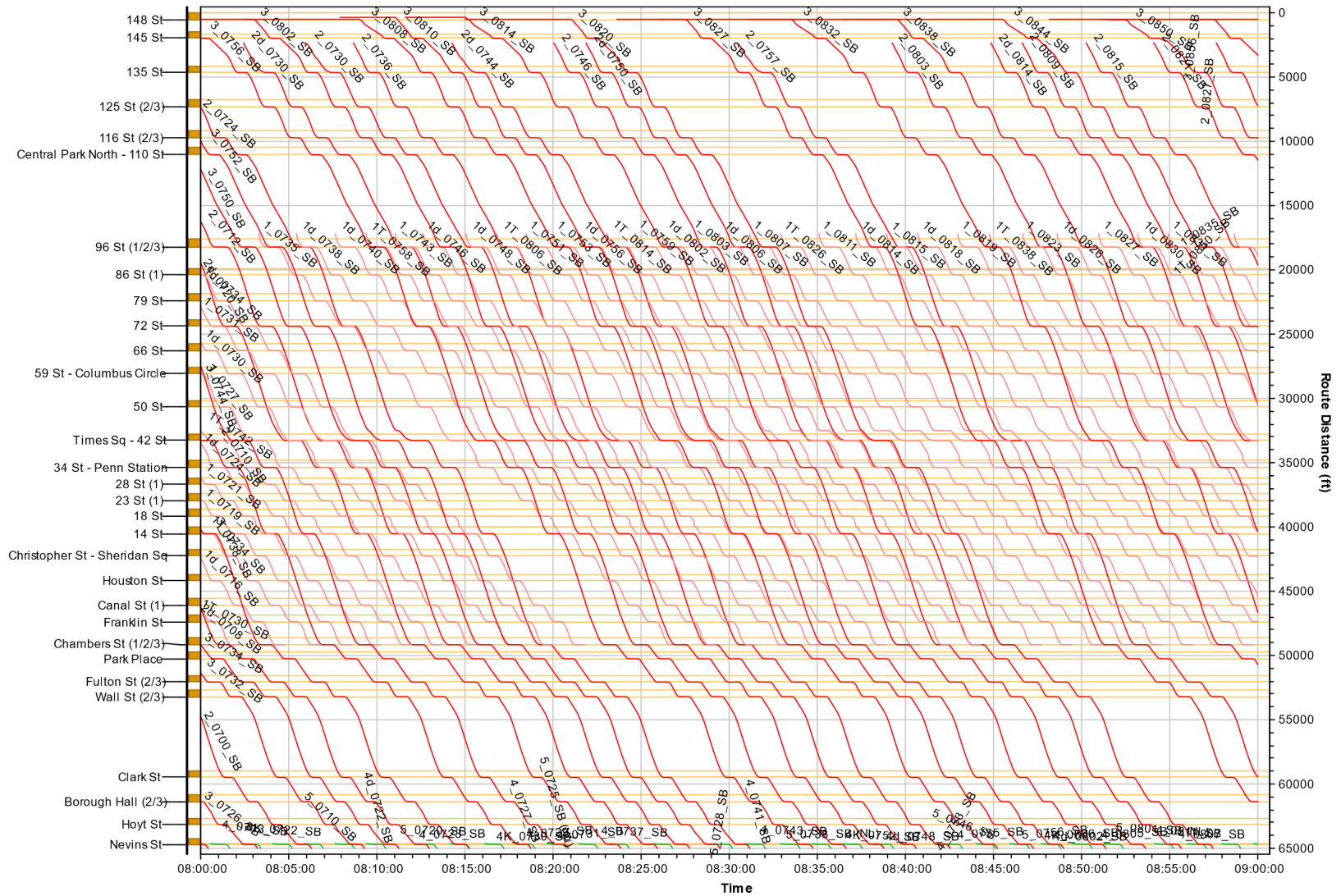
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-138: Future Baseline (CBTC) String Chart – Harlem-148 Street to Nevins Street – Southbound – 7:00 to 8:00 a.m.



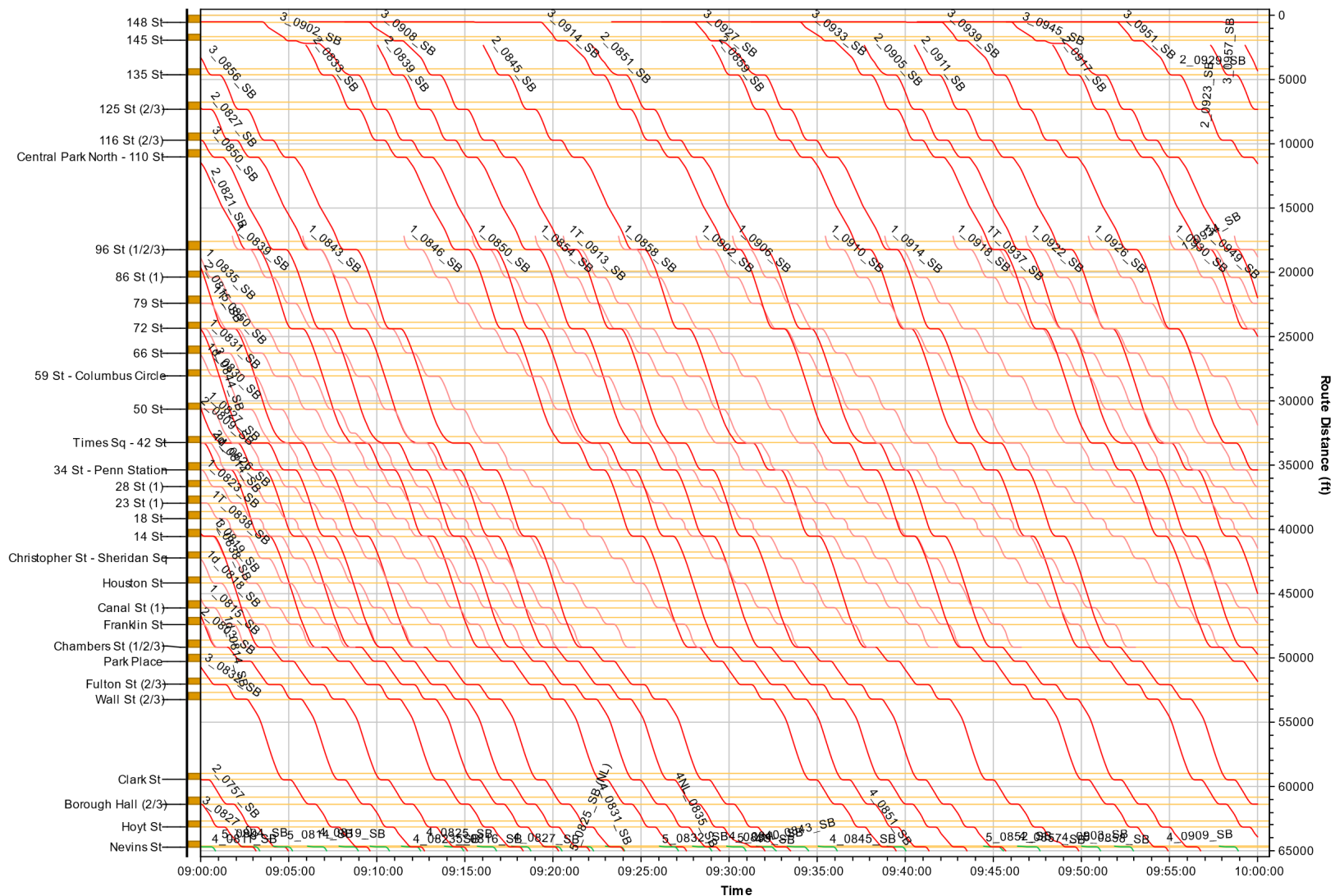
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-139: Future Baseline (CBTC) String Chart – Harlem-148 Street to Nevins Street – Southbound – 8:00 to 9:00 a.m.



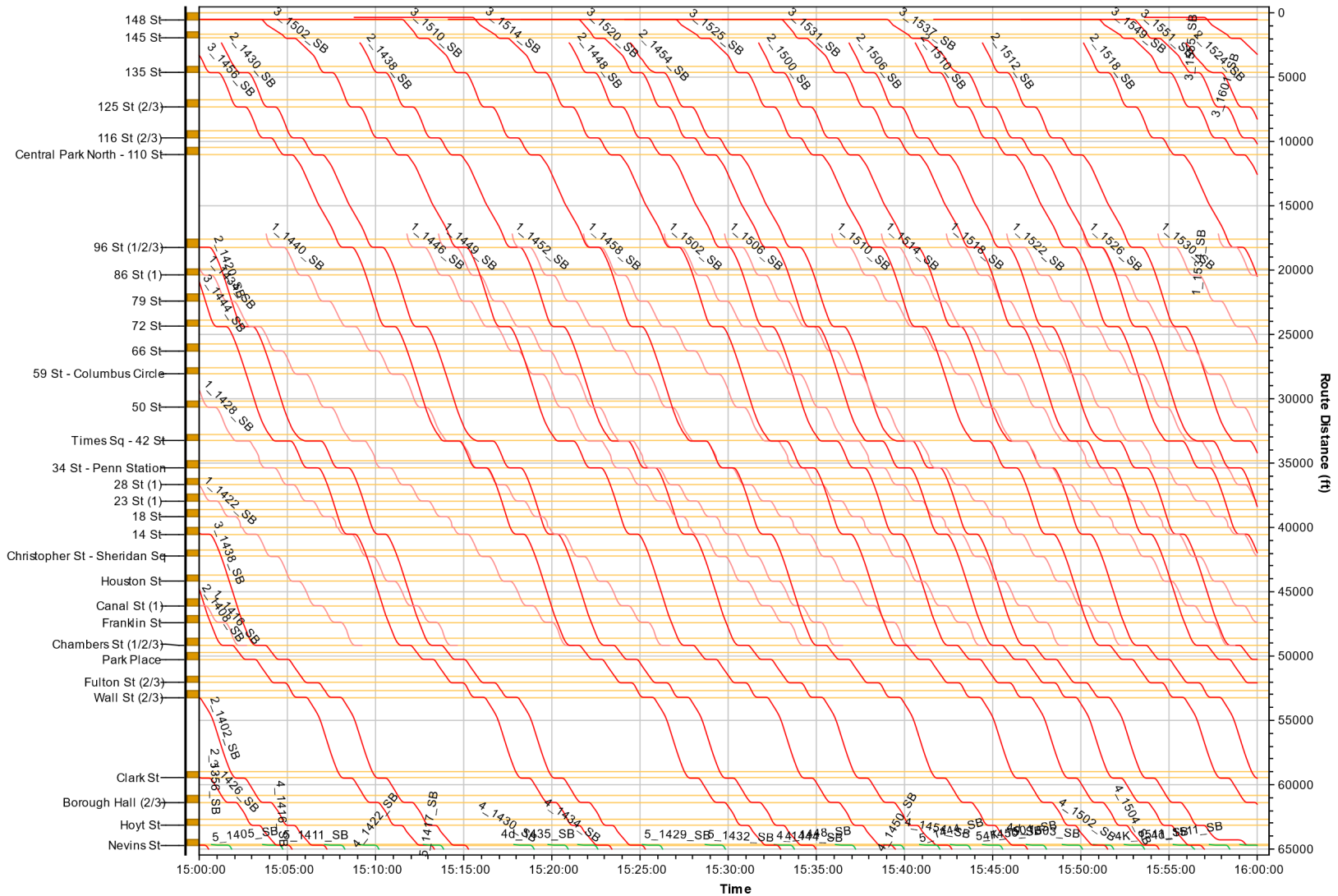
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-140: Future Baseline (CBTC) String Chart – Harlem-148 Street to Nevins Street – Southbound – 9:00 to 10:00 a.m.



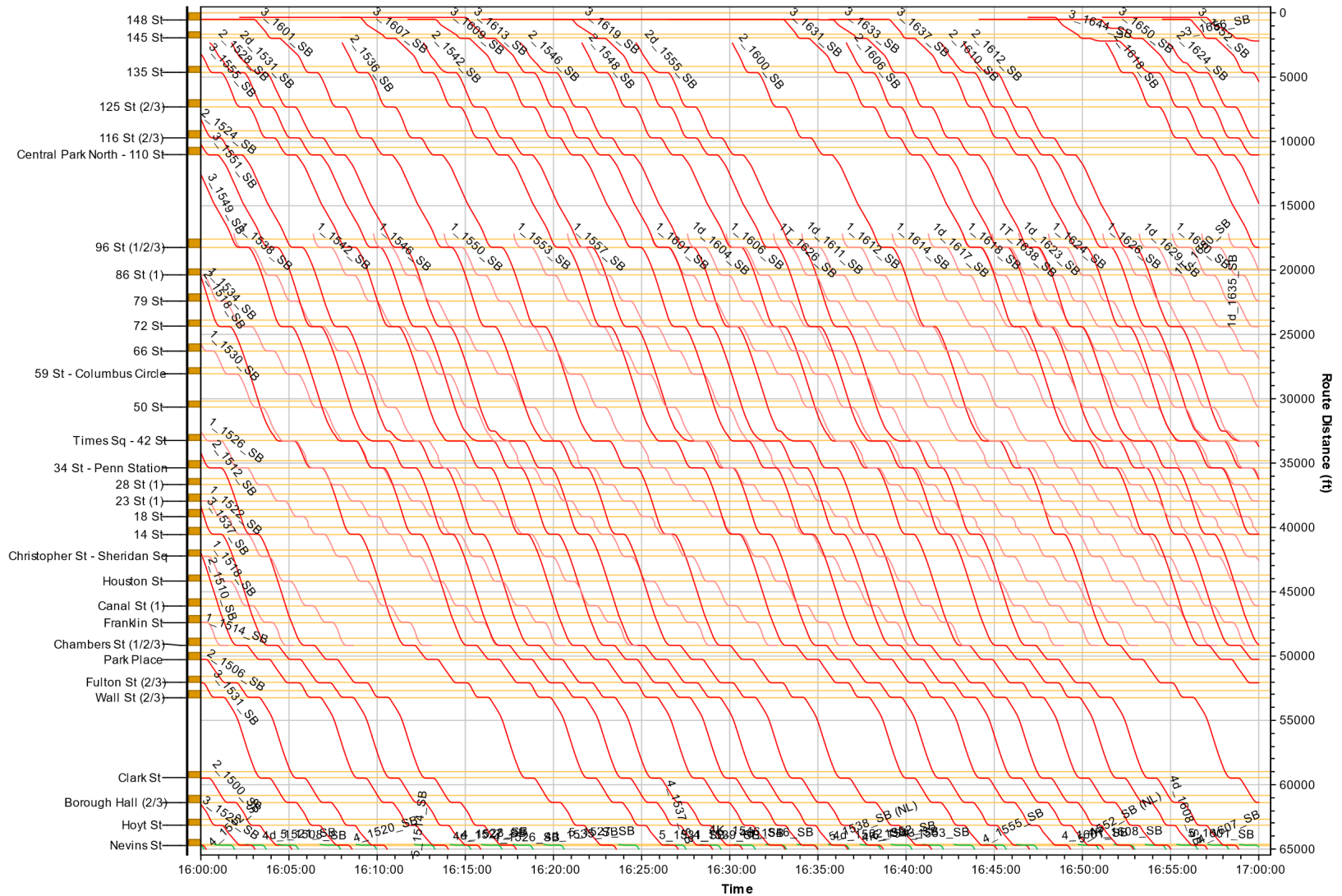
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-141: Future Baseline (CBTC) String Chart – Harlem-148 Street to Nevins Street – Southbound – 3:00 to 4:00 p.m.



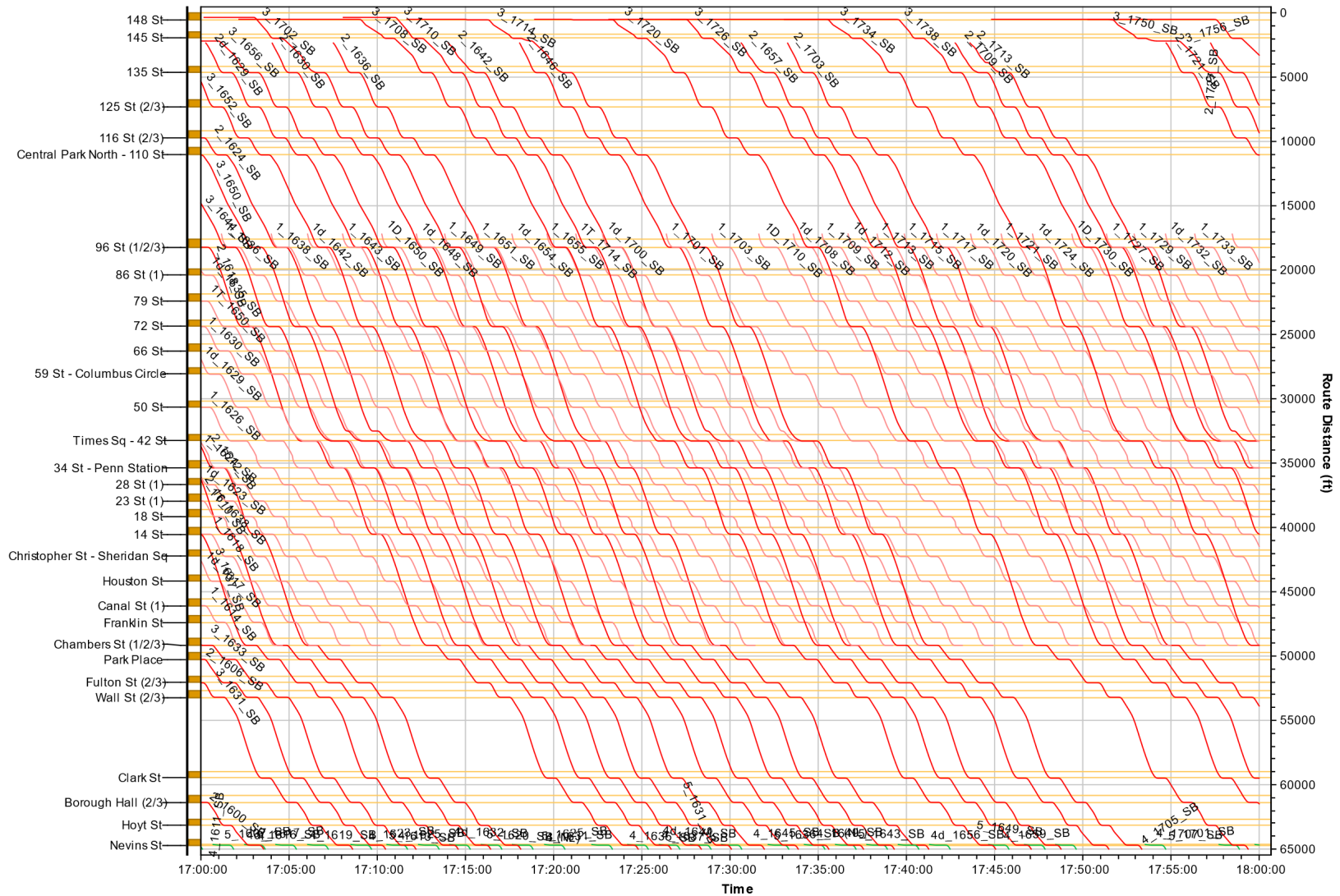
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-142: Future Baseline (CBTC) String Chart – Harlem-148 Street to Nevins Street – Southbound – 4:00 to 5:00 p.m.



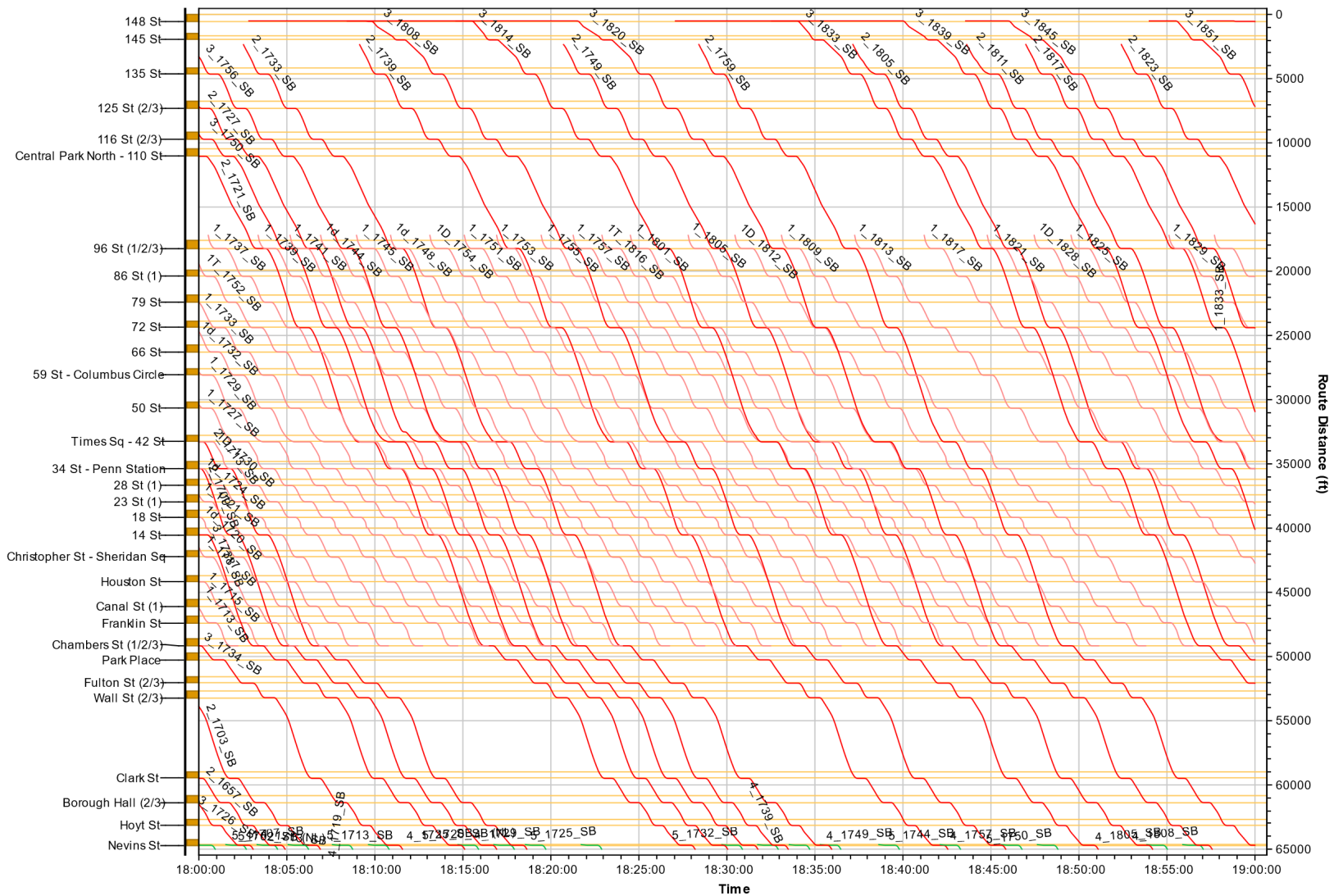
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-143: Future Baseline (CBTC) String Chart – Harlem-148 Street to Nevins Street – Southbound – 5:00 to 6:00 p.m.



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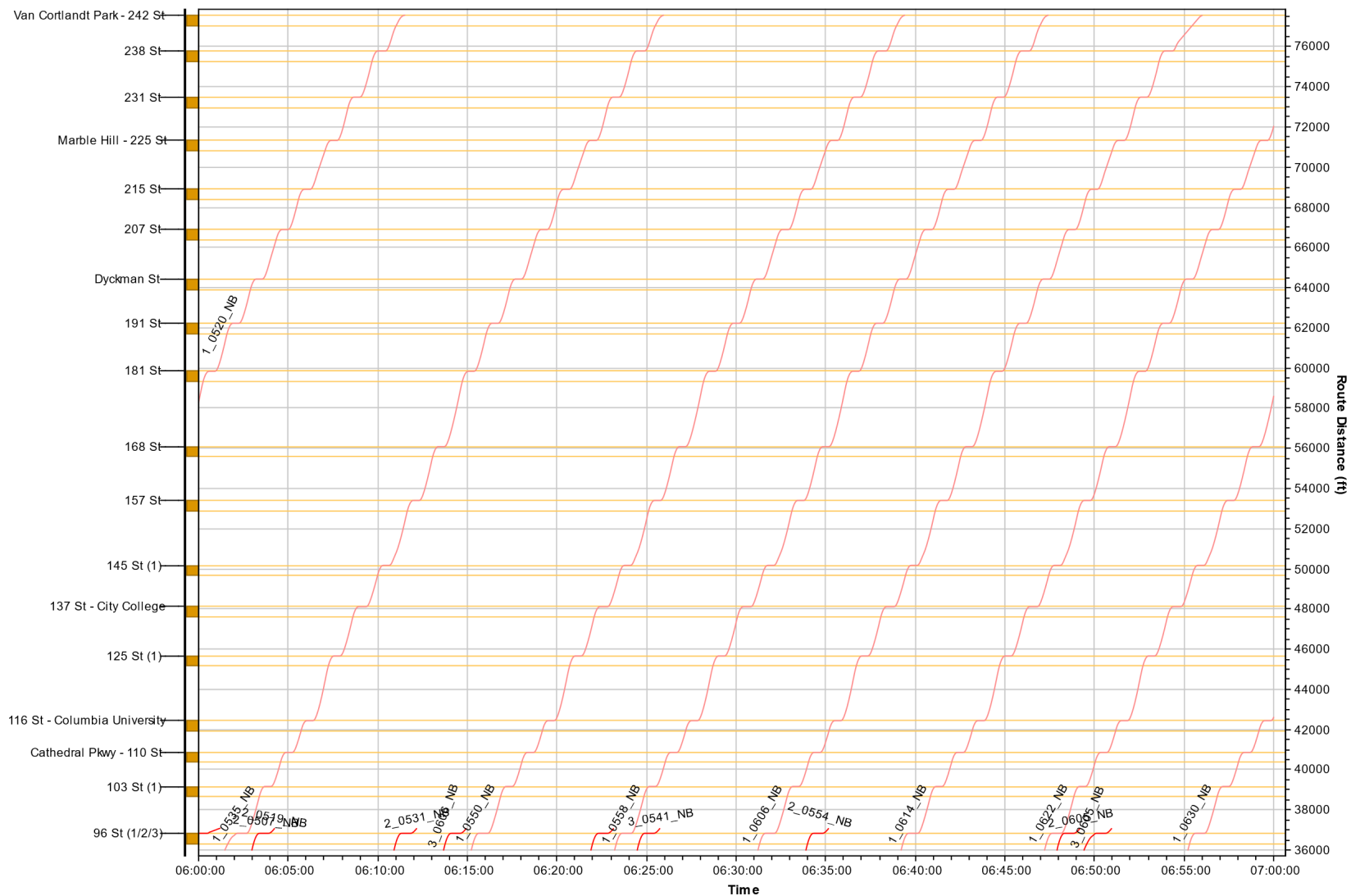
Figure G.4-144: Future Baseline (CBTC) String Chart – Harlem-148 Street to Nevins Street – Southbound – 6:00 to 7:00 p.m.



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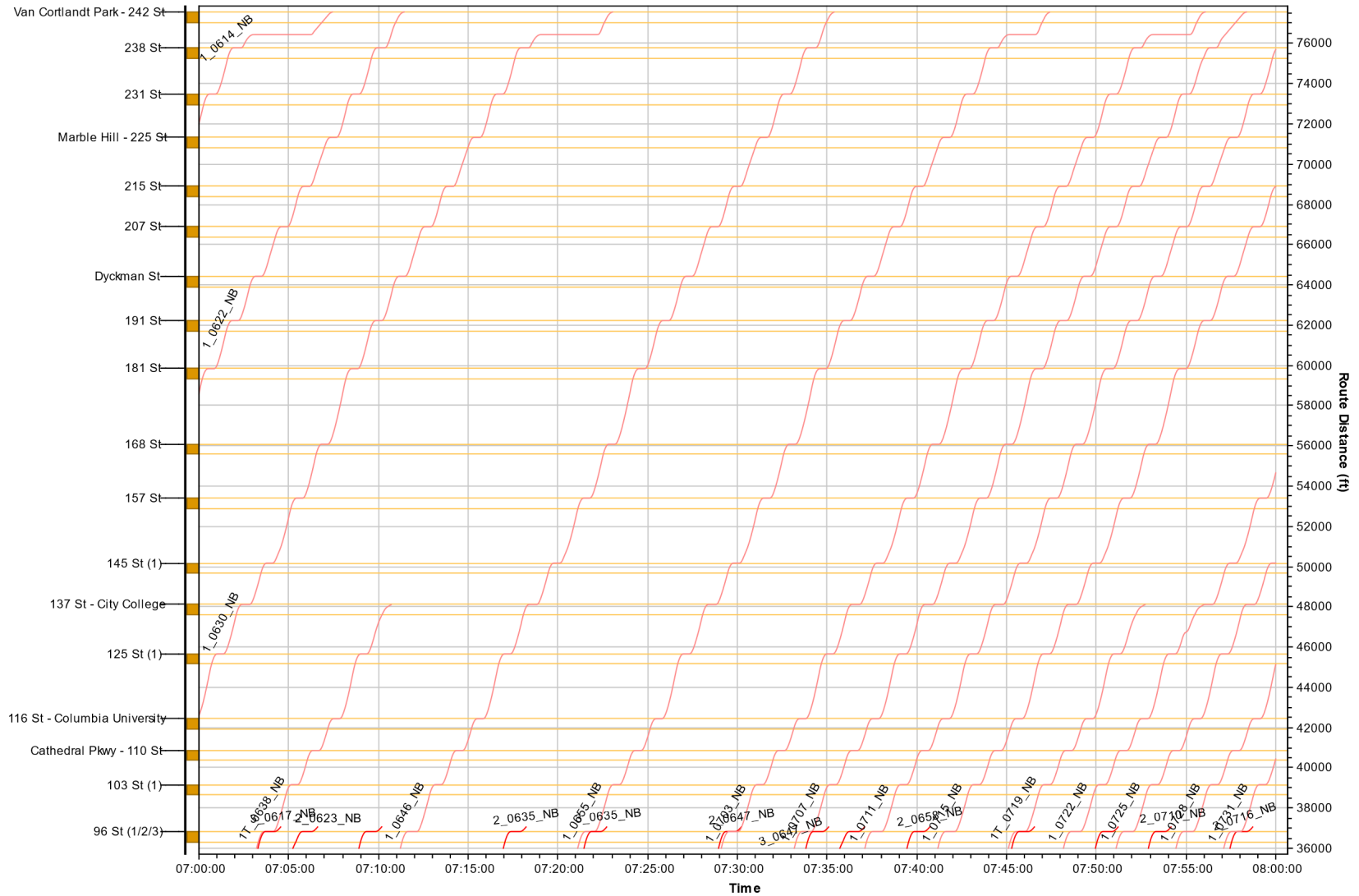
G.4.10 Van Cortlandt Park-242 Street to 96 Street

Figure G.4-145: Future Baseline (CBTC) String Chart – 96 Street to Van Cortlandt Park-242 Street – Northbound – 6:00 to 7:00 a.m.



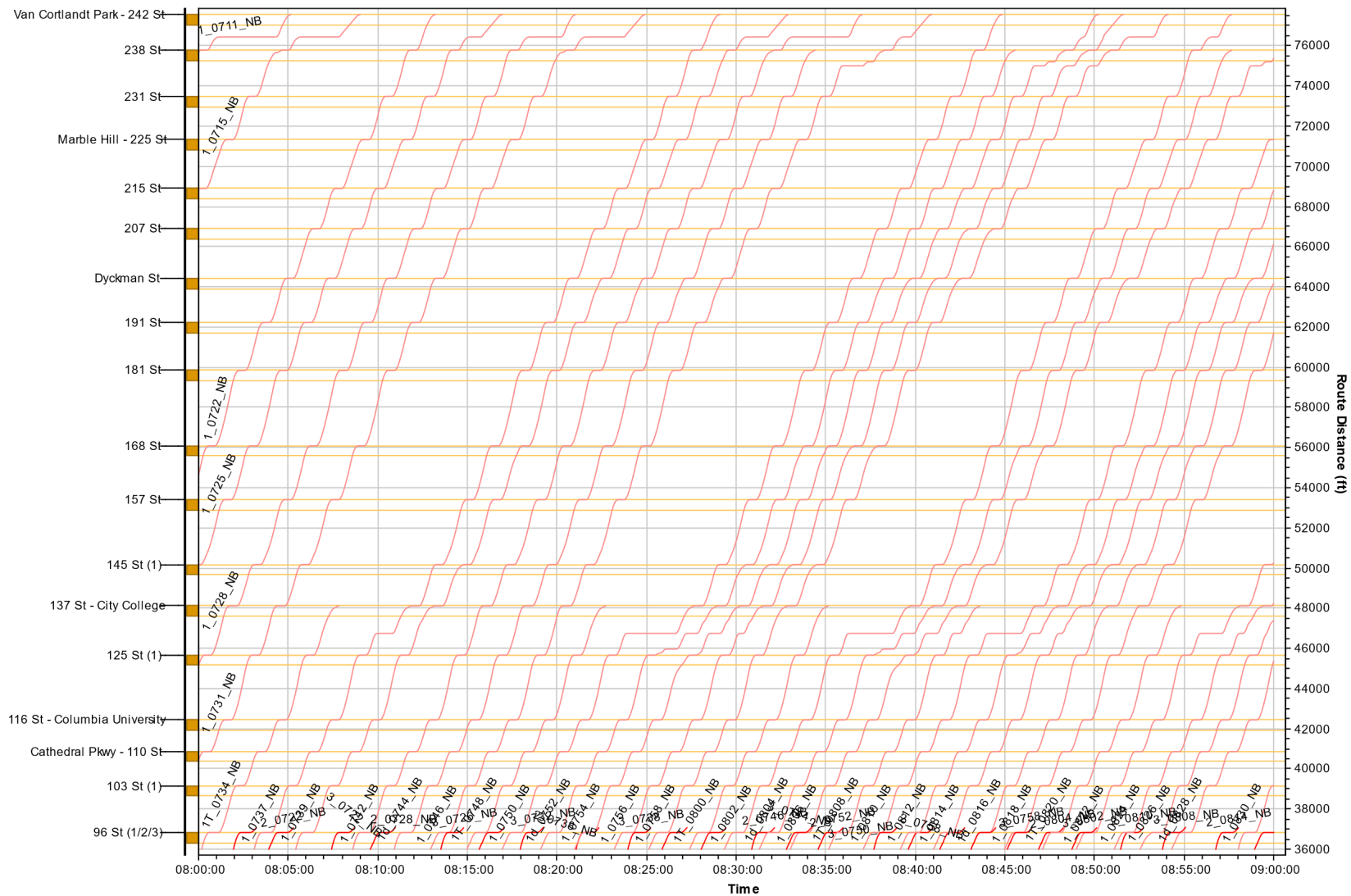
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-146: Future Baseline (CBTC) String Chart – 96 Street to Van Cortlandt Park-242 Street – Northbound – 7:00 to 8:00 a.m.



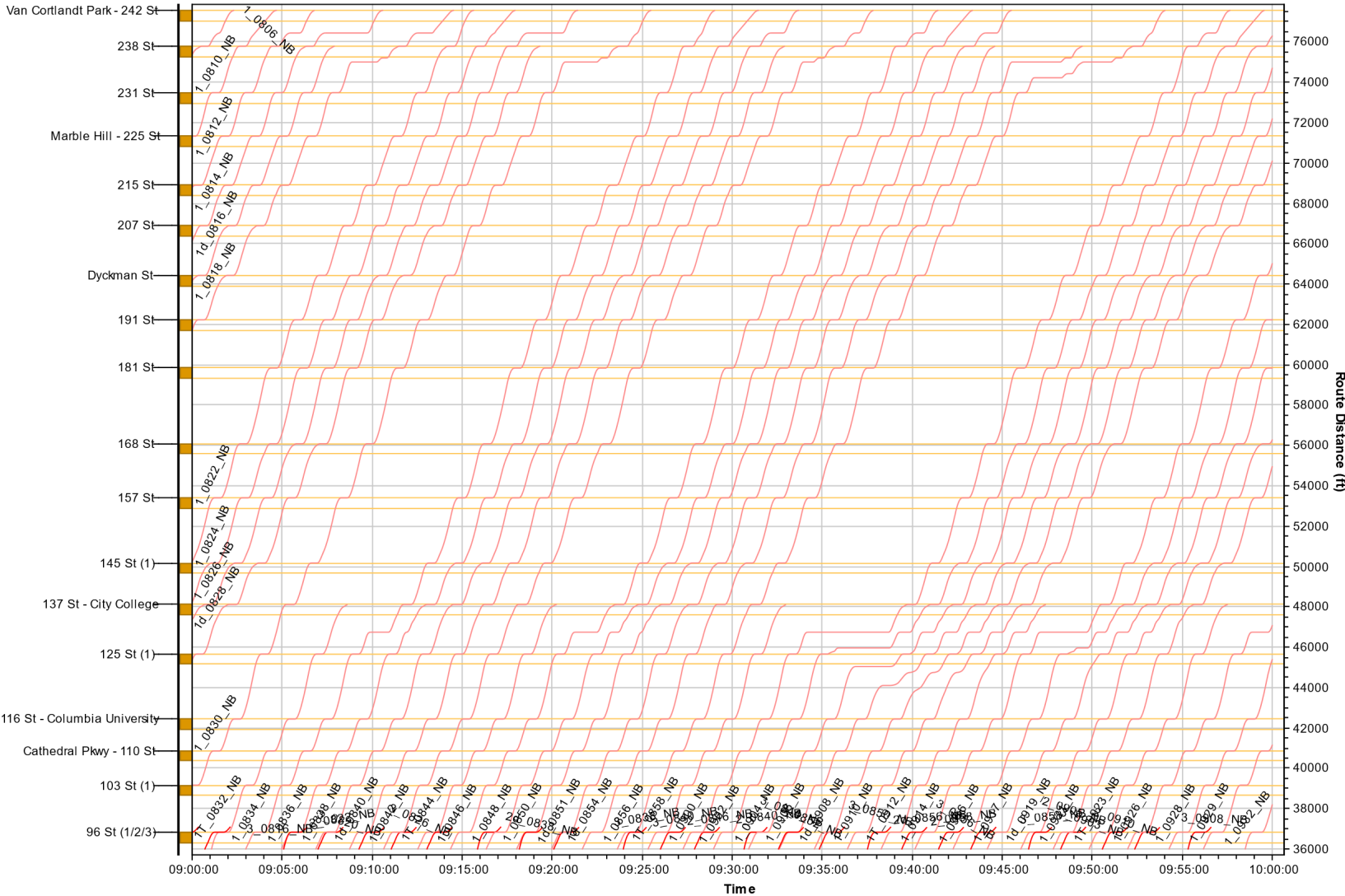
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-147: Future Baseline (CBTC) String Chart – 96 Street to Van Cortlandt Park-242 Street – Northbound – 8:00 to 9:00 a.m.



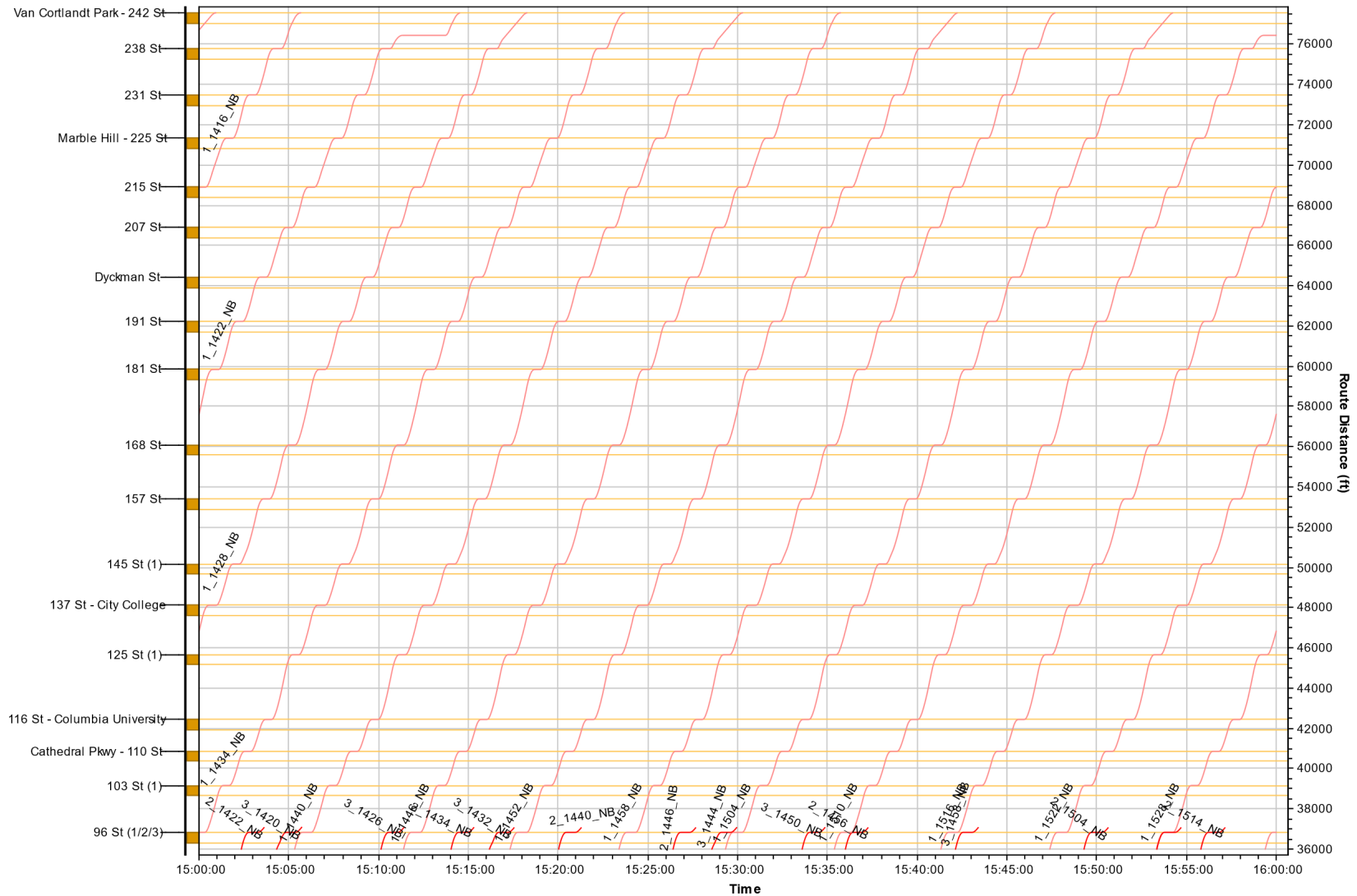
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-148: Future Baseline (CBTC) String Chart – 96 Street to Van Cortlandt Park-242 Street – Northbound – 9:00 to 10:00 a.m.



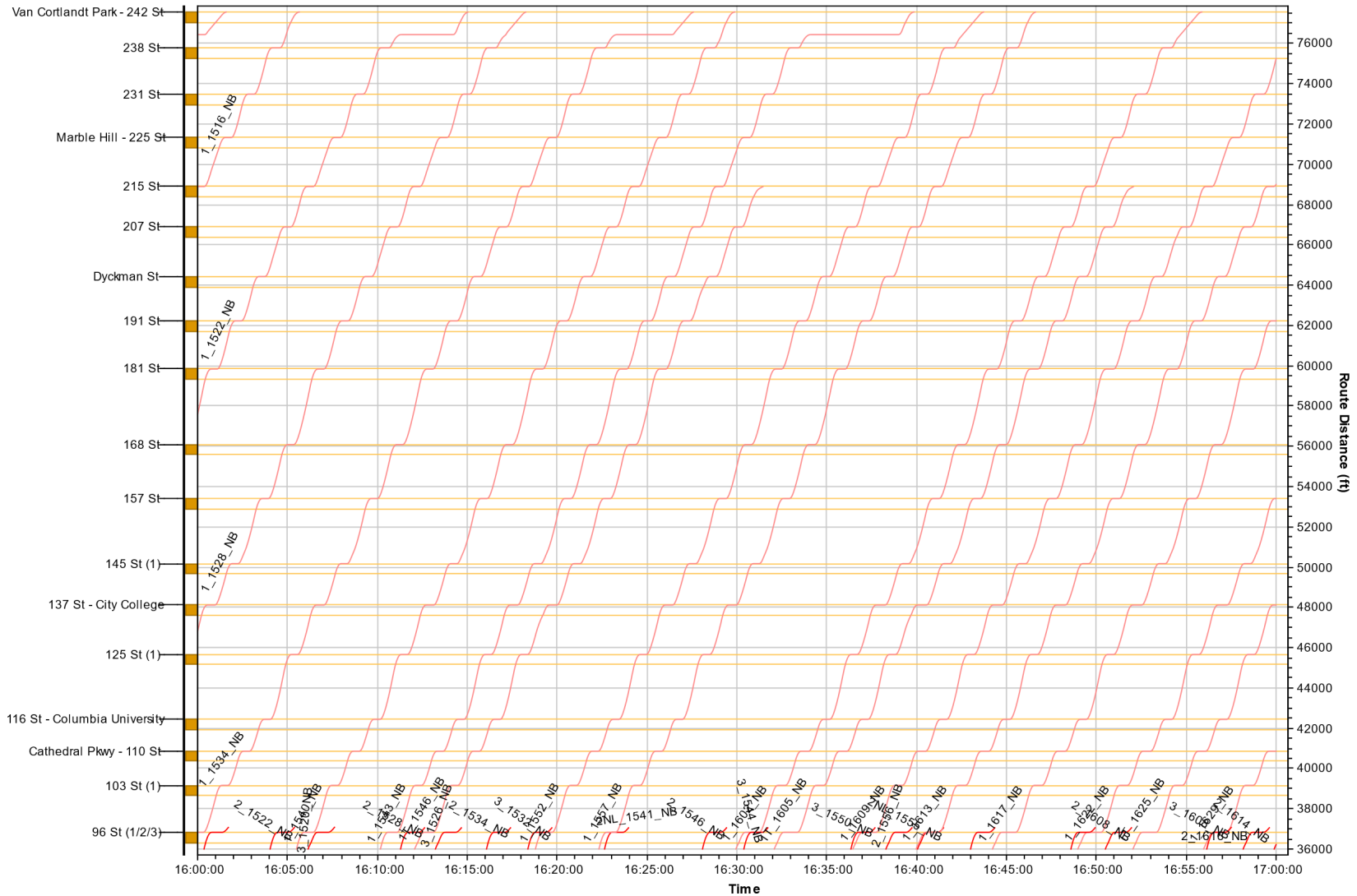
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Figure G.4-149: Future Baseline (CBTC) String Chart – 96 Street to Van Cortlandt Park-242 Street – Northbound – 3:00 to 4:00 p.m.



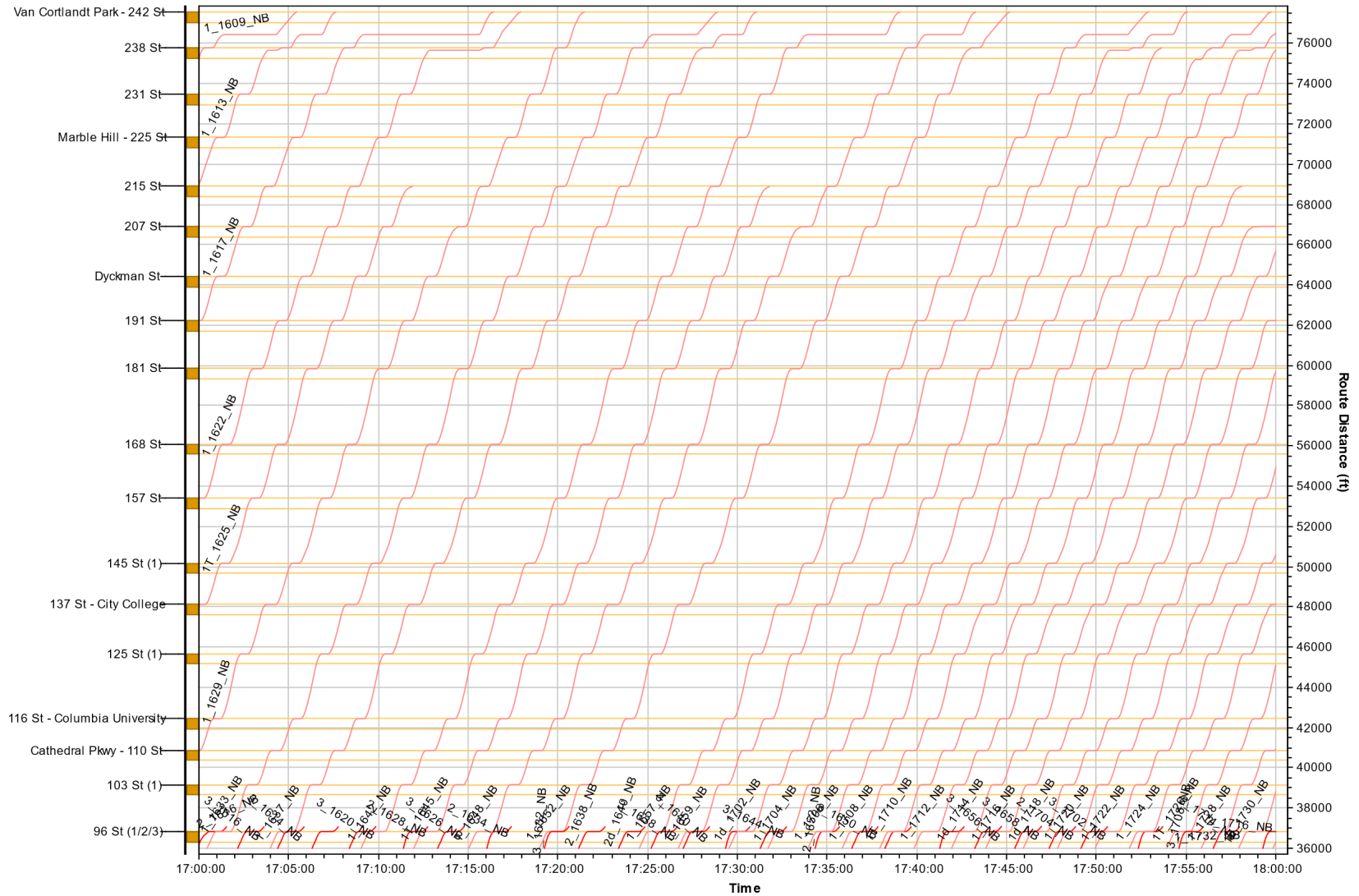
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-150: Future Baseline (CBTC) String Chart – 96 Street to Van Cortlandt Park-242 Street – Northbound – 4:00 to 5:00 p.m.



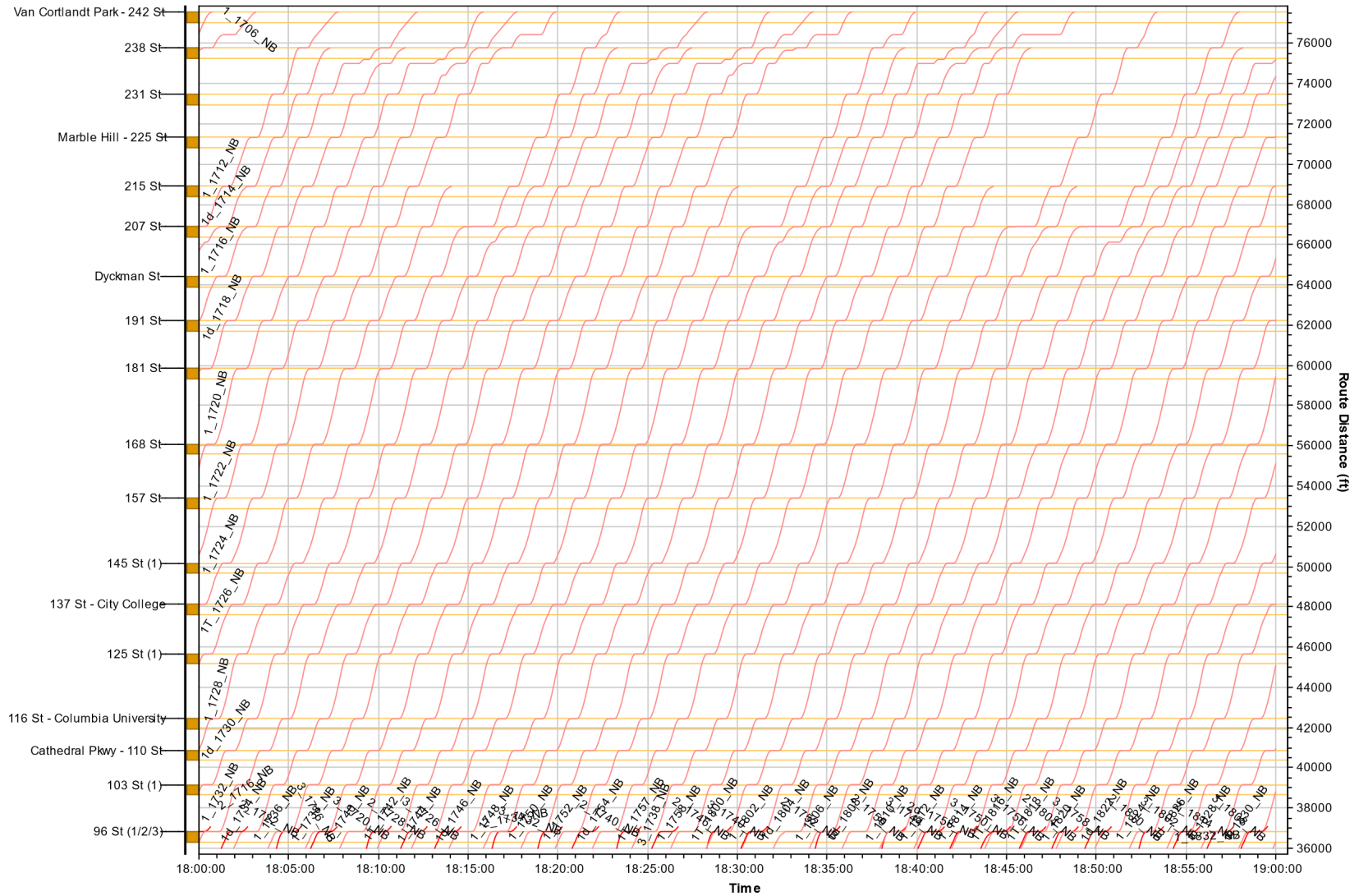
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-151: Future Baseline (CBTC) String Chart – 96 Street to Van Cortlandt Park-242 Street – Northbound – 5:00 to 6:00 p.m.



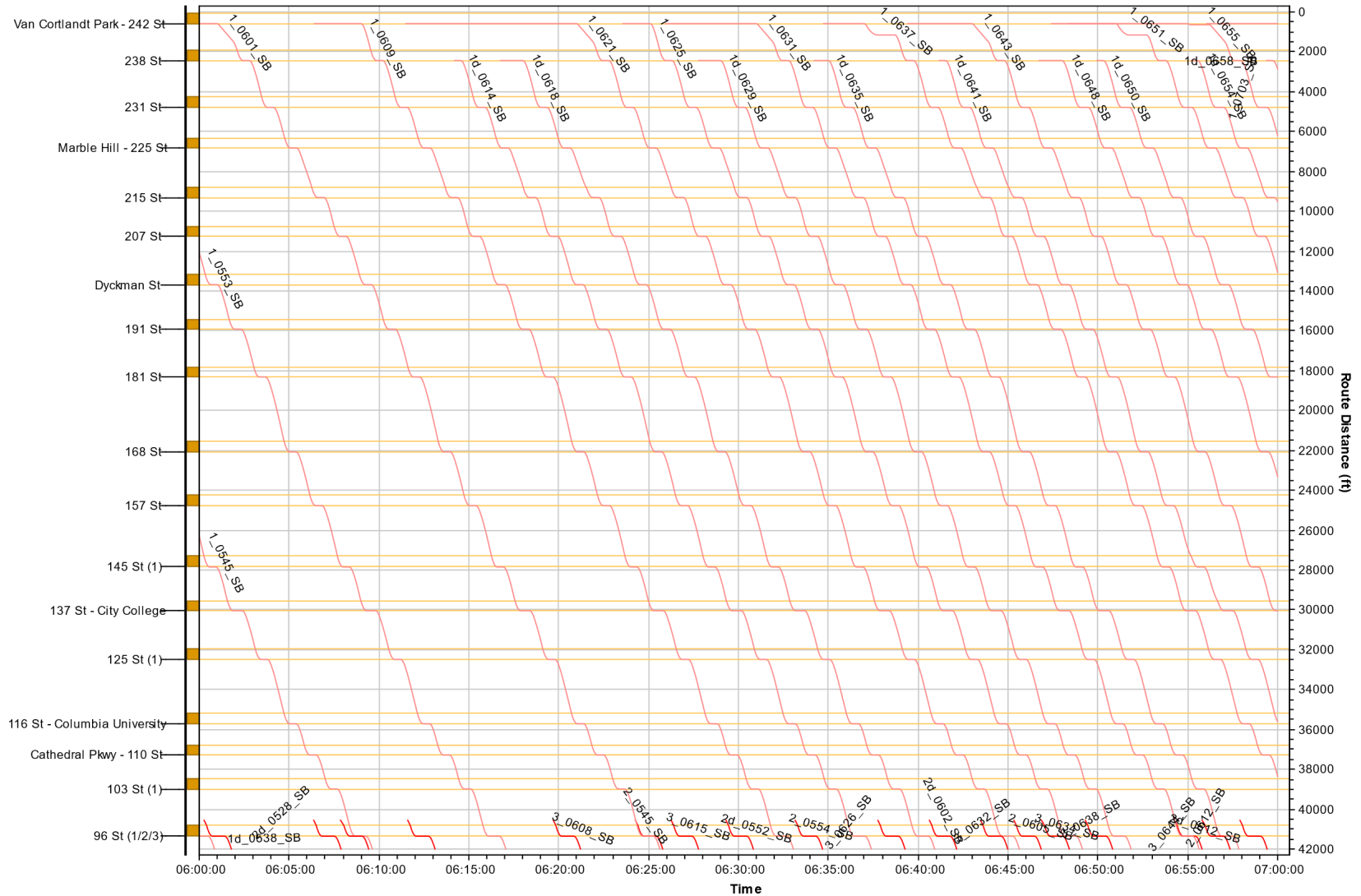
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-152: Future Baseline (CBTC) String Chart – 96 Street to Van Cortlandt Park-242 Street – Northbound – 6:00 to 7:00 p.m.



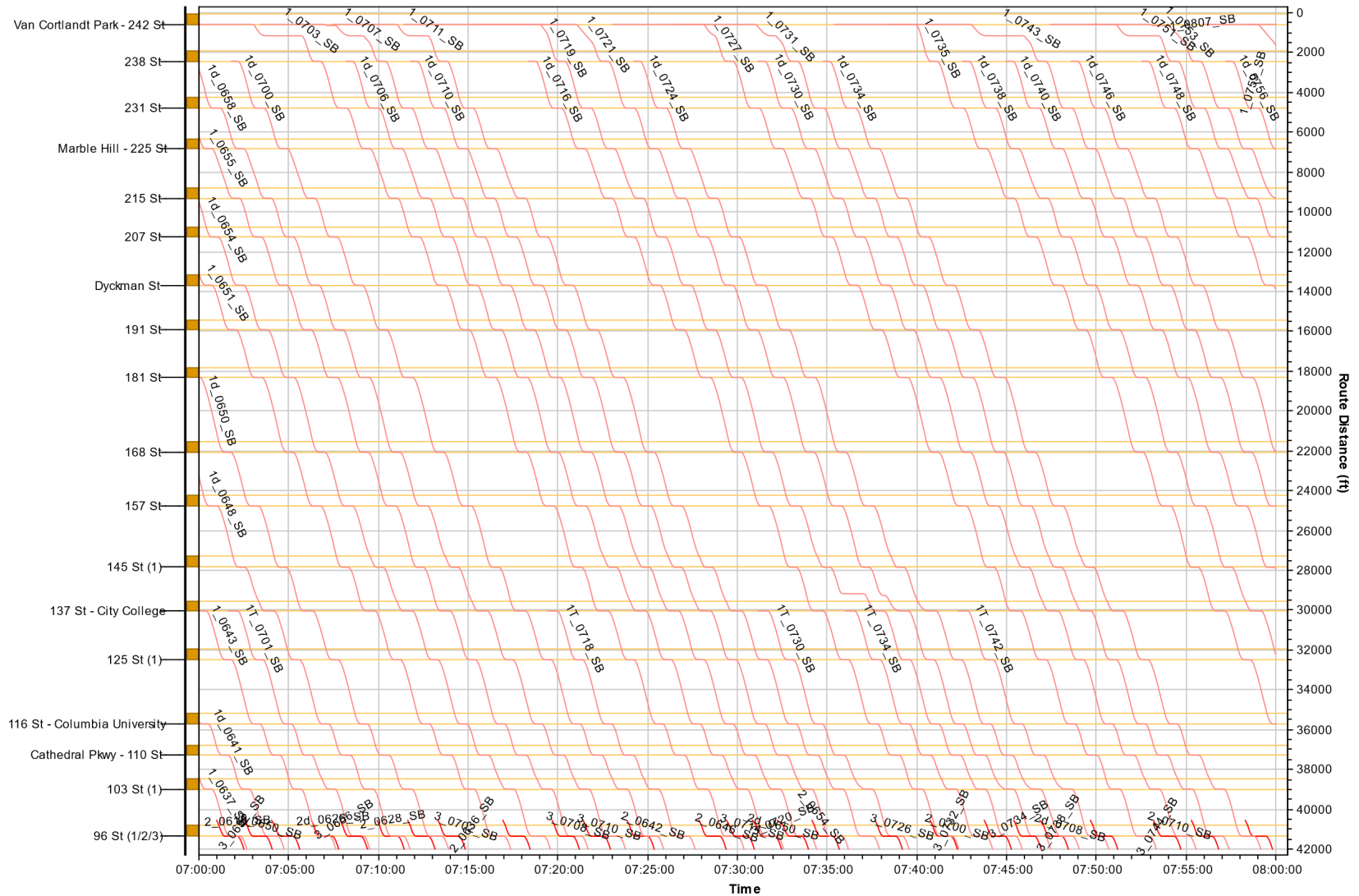
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-153: Future Baseline (CBTC) String Chart – Van Cortlandt Park-242 Street to 96 Street – Southbound – 6:00 to 7:00 a.m.



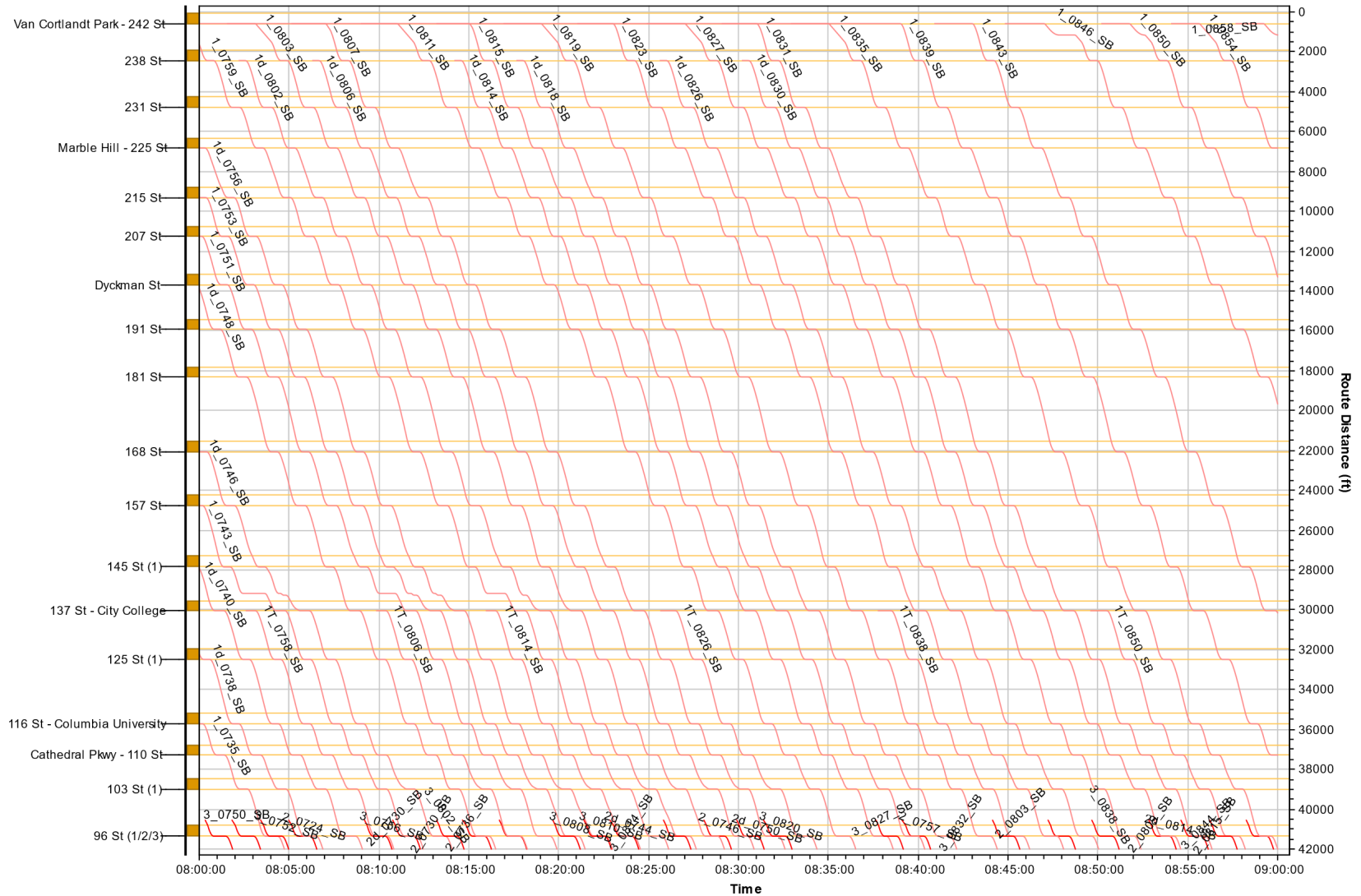
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-154: Future Baseline (CBTC) String Chart – Van Cortlandt Park-242 Street to 96 Street – Southbound – 7:00 to 8:00 a.m.



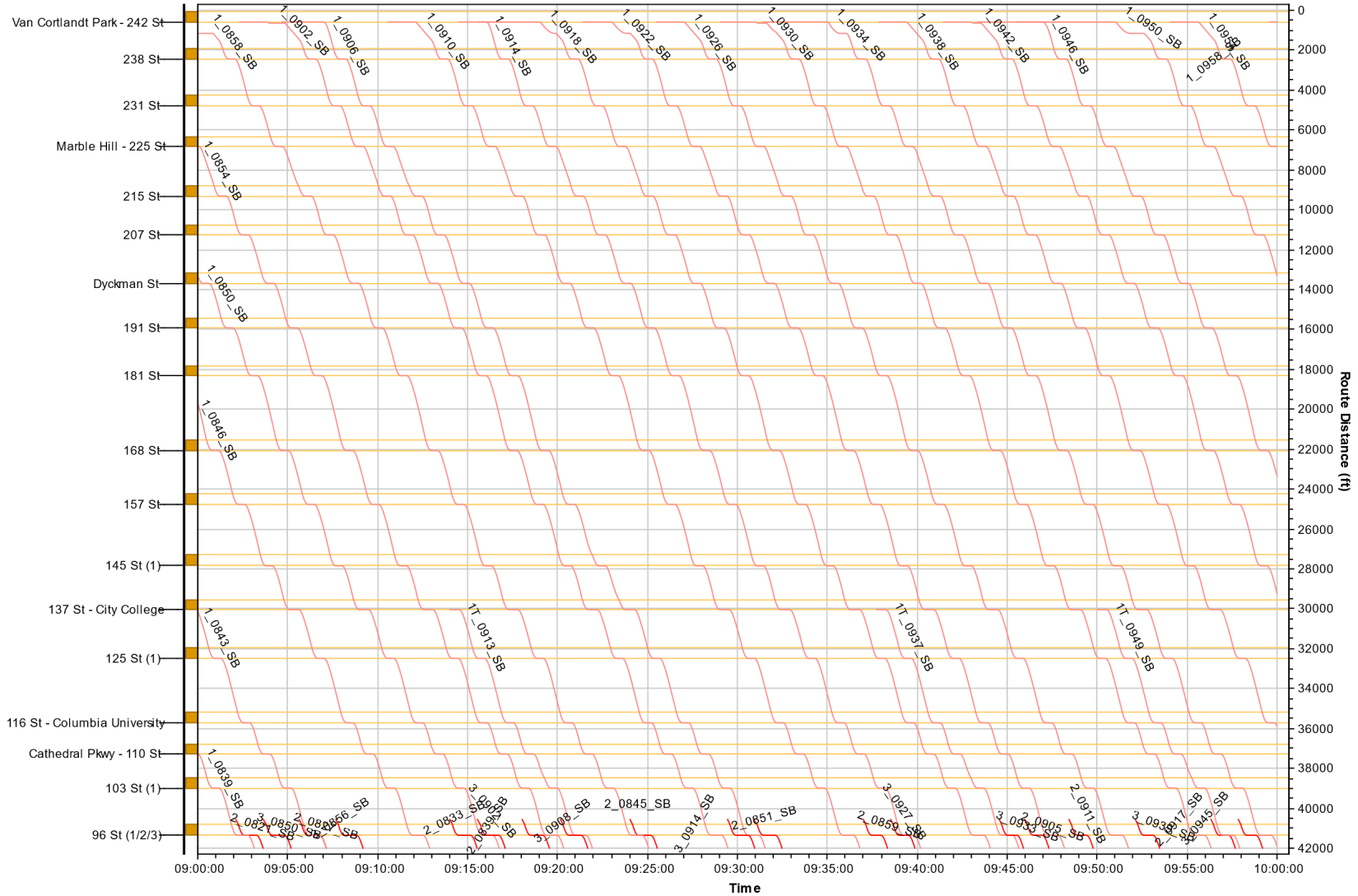
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-155: Future Baseline (CBTC) String Chart – Van Cortlandt Park-242 Street to 96 Street – Southbound – 8:00 to 9:00 a.m.



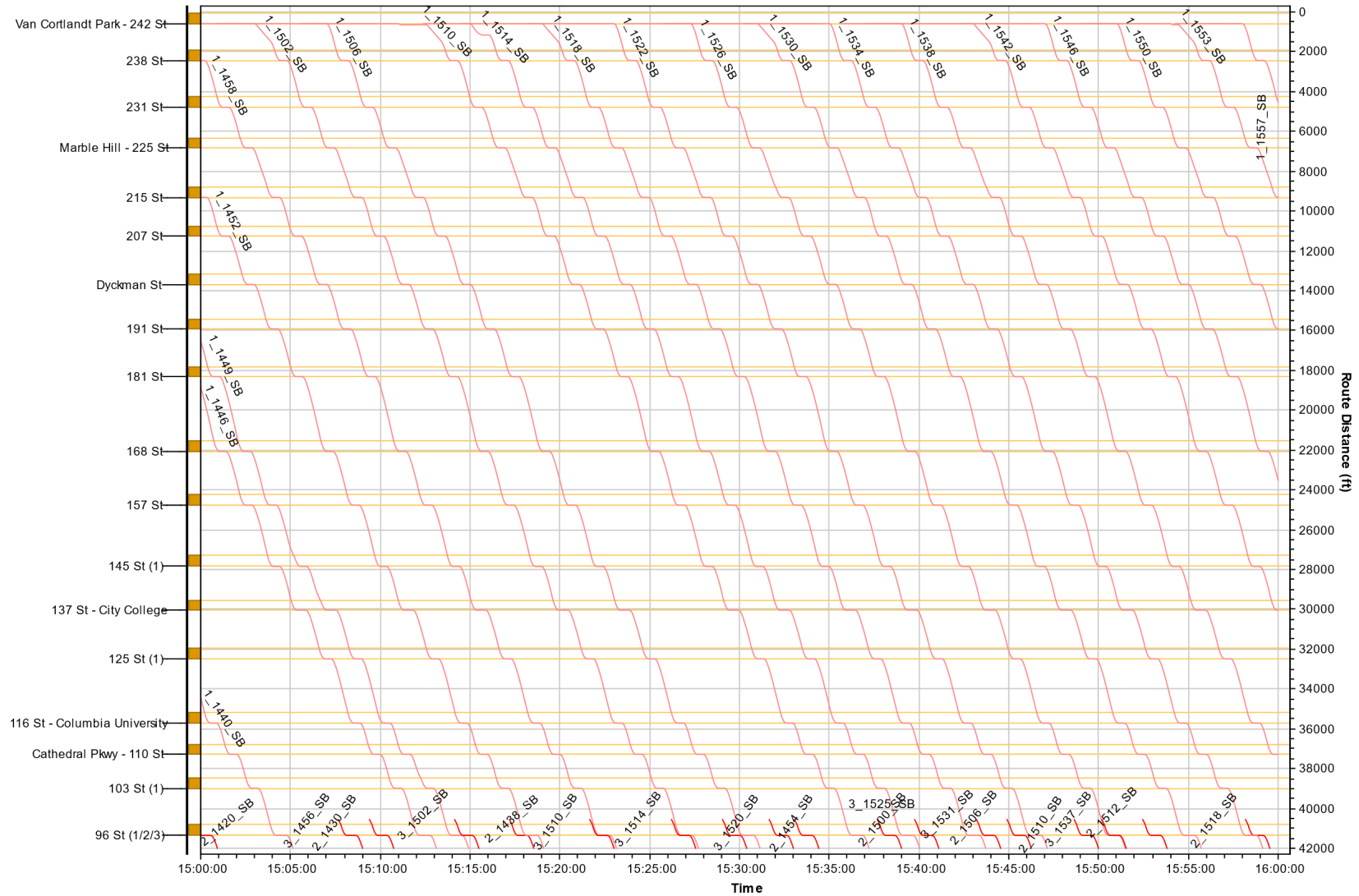
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-156: Future Baseline (CBTC) String Chart – Van Cortlandt Park-242 Street to 96 Street – Southbound – 9:00 to 10:00 a.m.



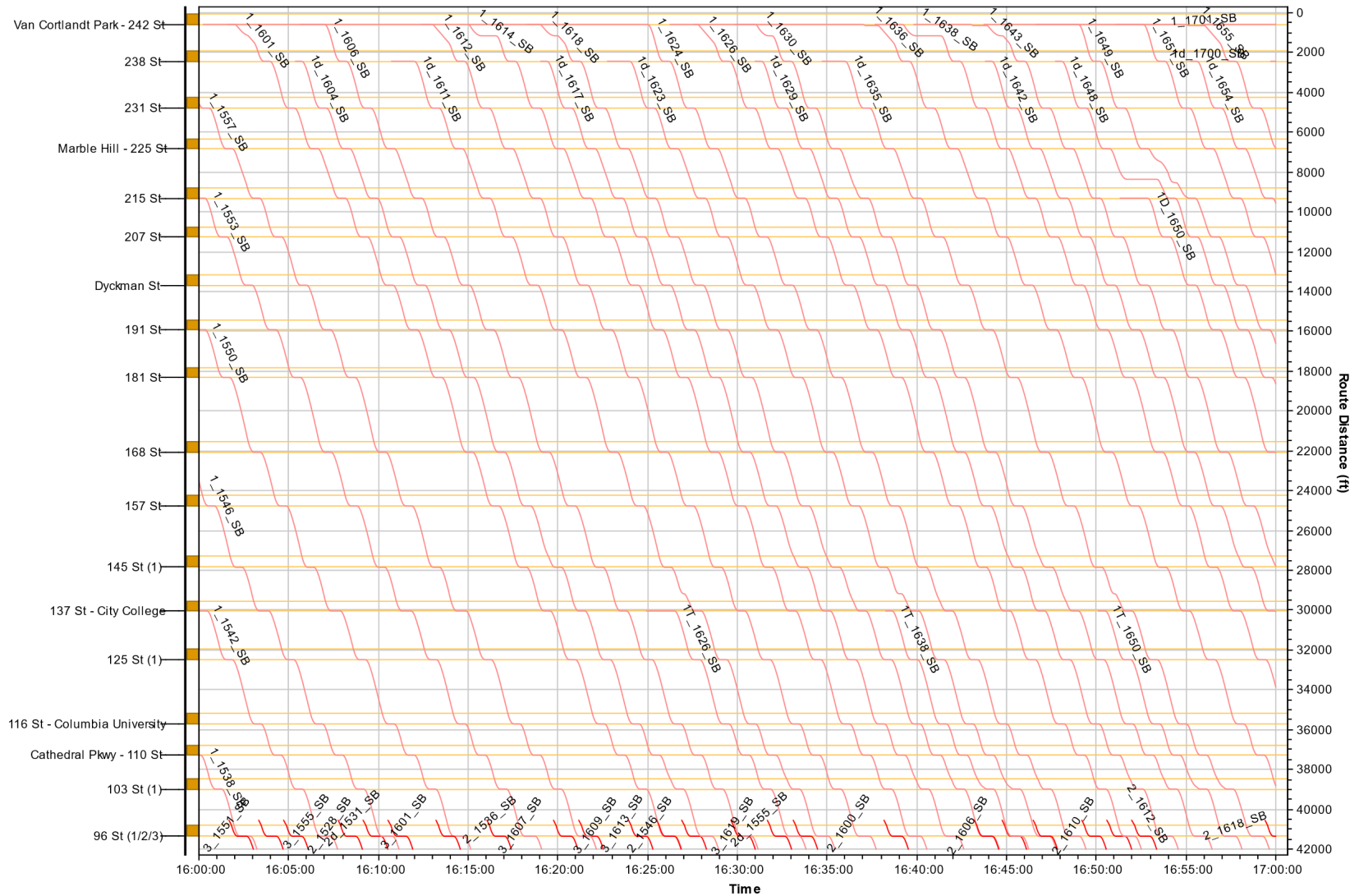
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-157: Future Baseline (CBTC) String Chart – Van Cortlandt Park-242 Street to 96 Street – Southbound – 3:00 to 4:00 p.m.



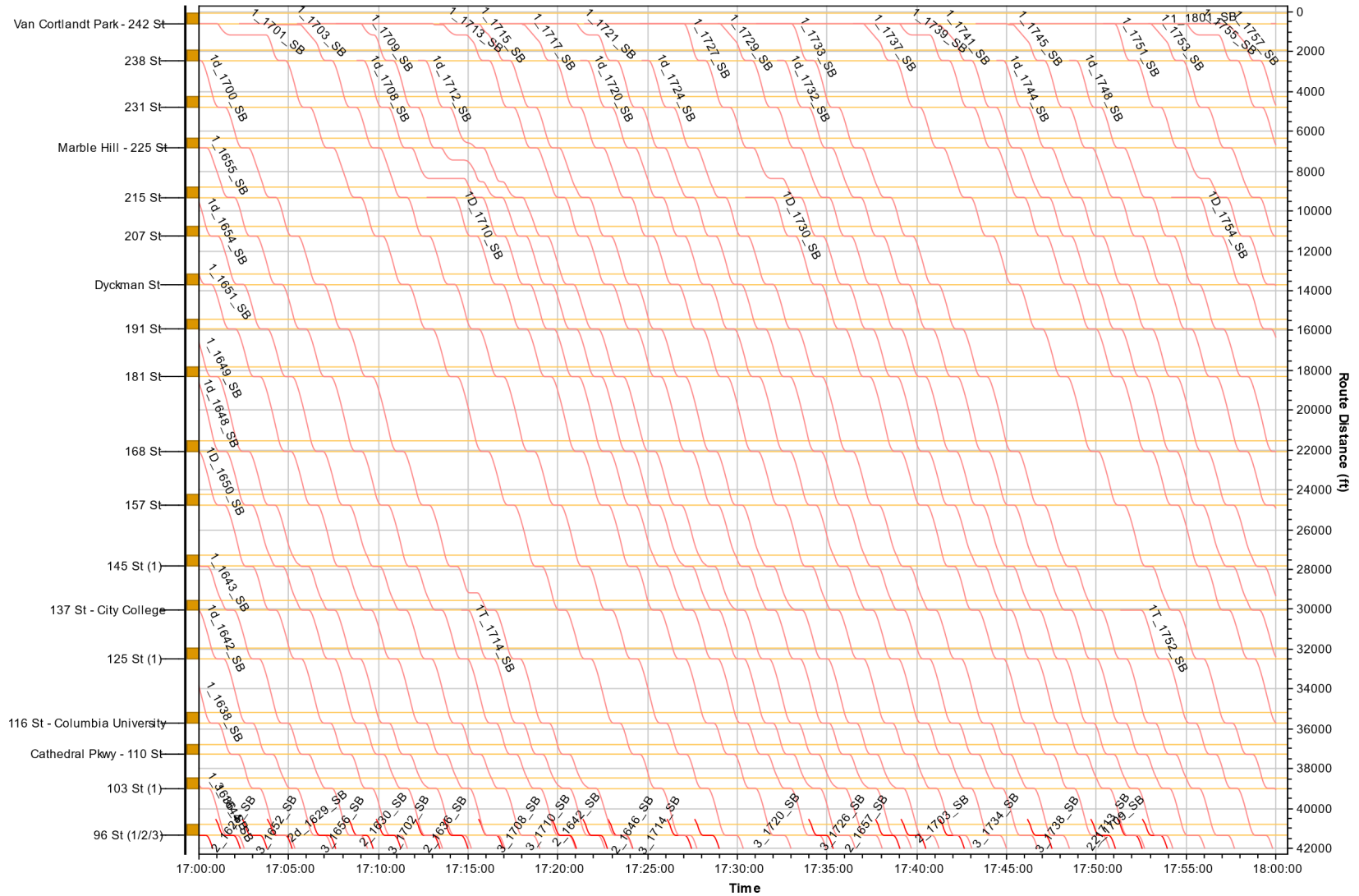
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-158: Future Baseline (CBTC) String Chart – Van Cortlandt Park-242 Street to 96 Street – Southbound – 4:00 to 5:00 p.m.



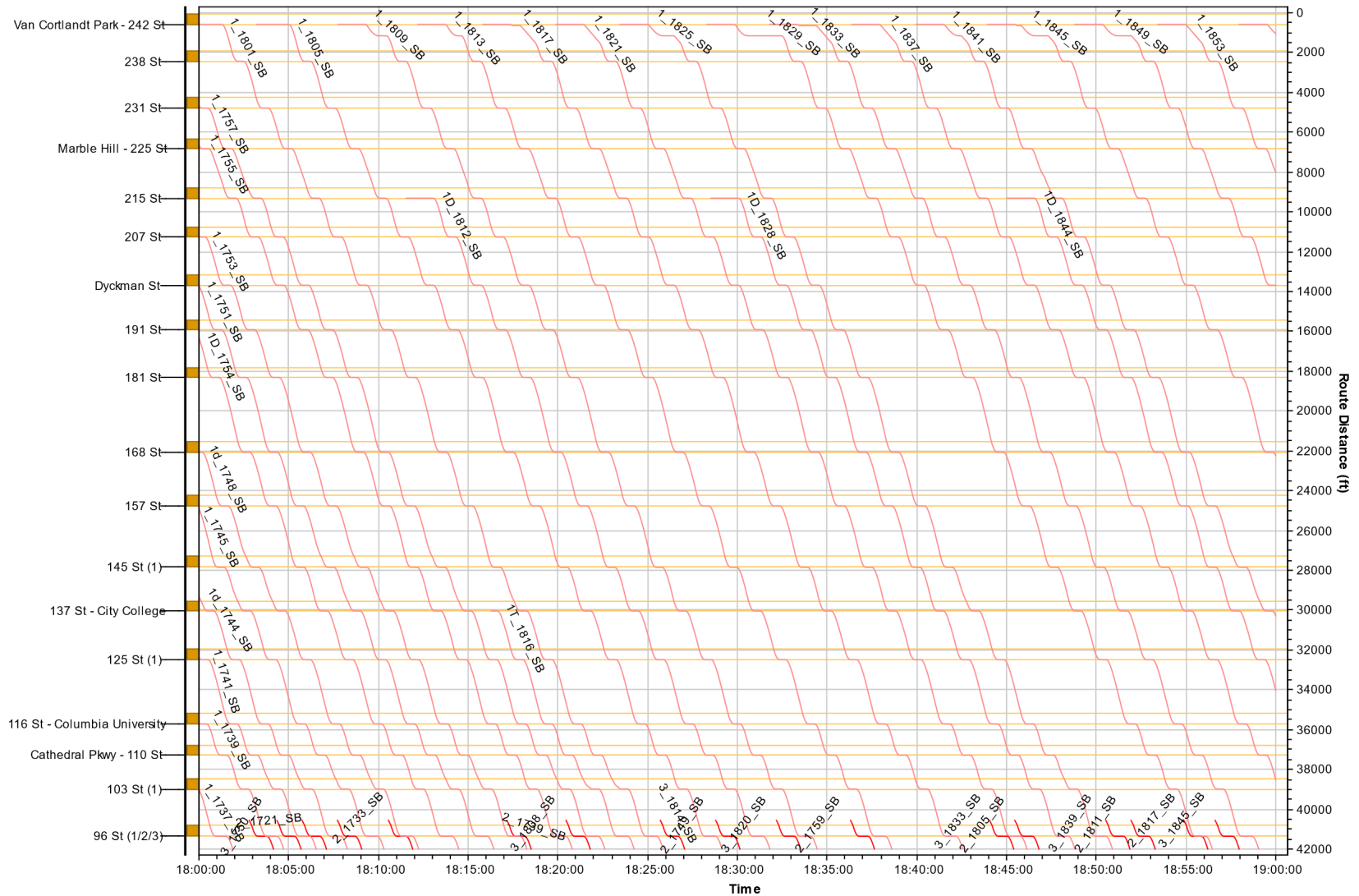
APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-159: Future Baseline (CBTC) String Chart – Van Cortlandt Park-242 Street to 96 Street – Southbound – 5:00 to 6:00 p.m.



APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.4-160: Future Baseline (CBTC) String Chart – Van Cortlandt Park-242 Street to 96 Street – Southbound – 6:00 to 7:00 p.m.



G.5 Simulated Station Occupancy Charts

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APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

G.5.1 New Lots Avenue

Figure G.5-1: Future Baseline (CBTC) Station Occupancy Chart – New Lots Avenue– 6:00 to 7:00 a.m.

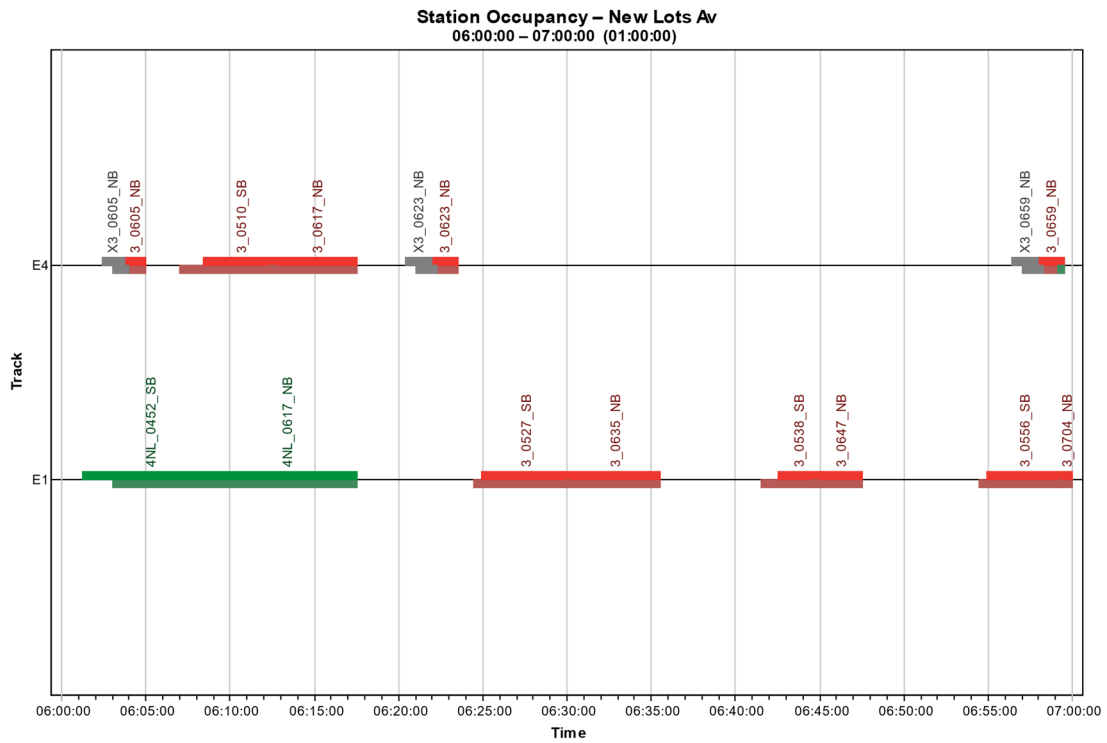
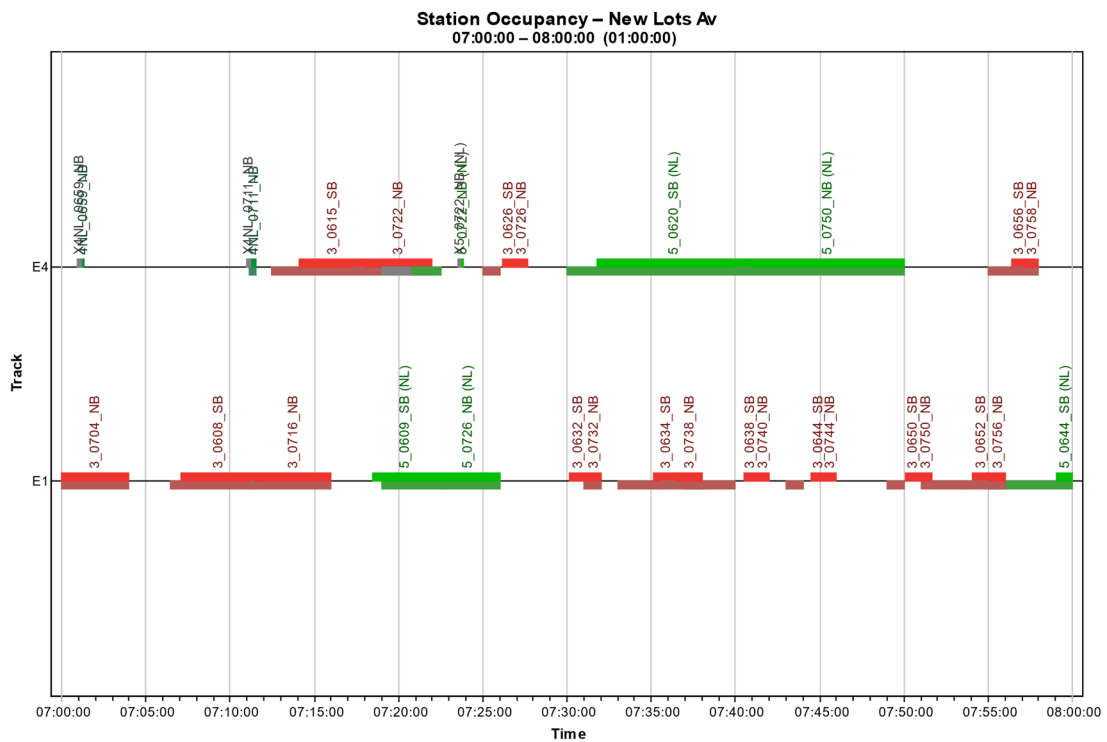


Figure G.5-2: Future Baseline (CBTC) Station Occupancy Chart - New Lots Avenue - 7:00 to 8:00 a.m.



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Figure G.5-3: Future Baseline (CBTC) Station Occupancy Chart - New Lots Avenue - 8:00 to 9:00 a.m.

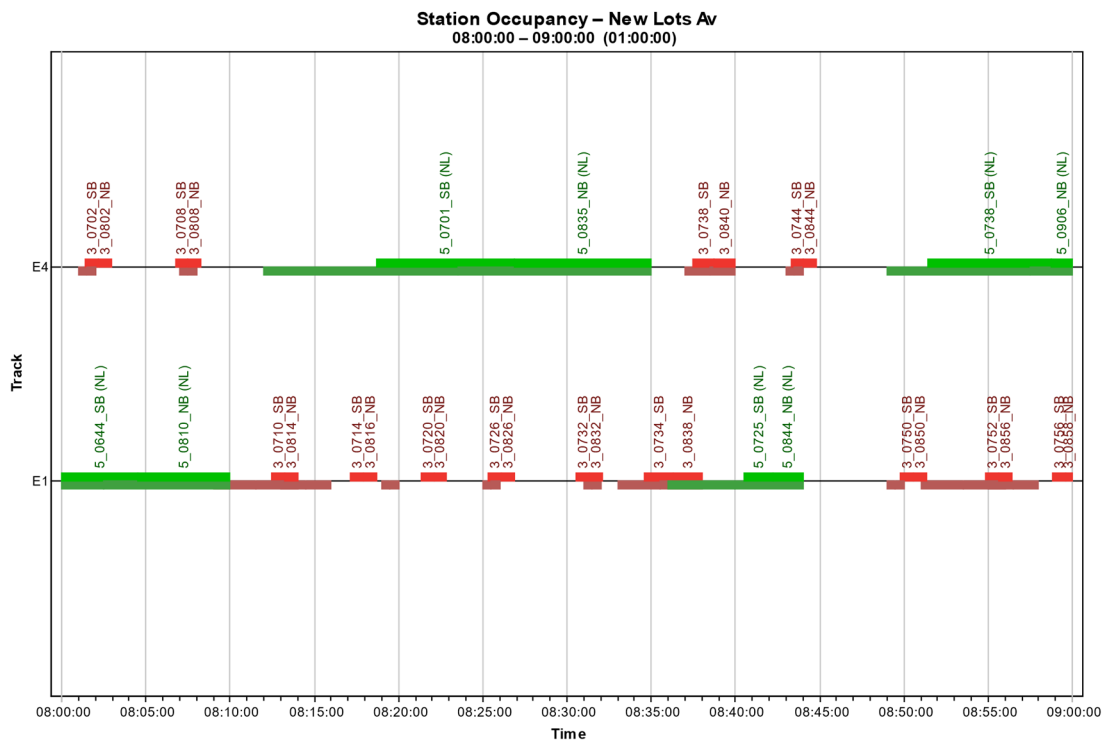
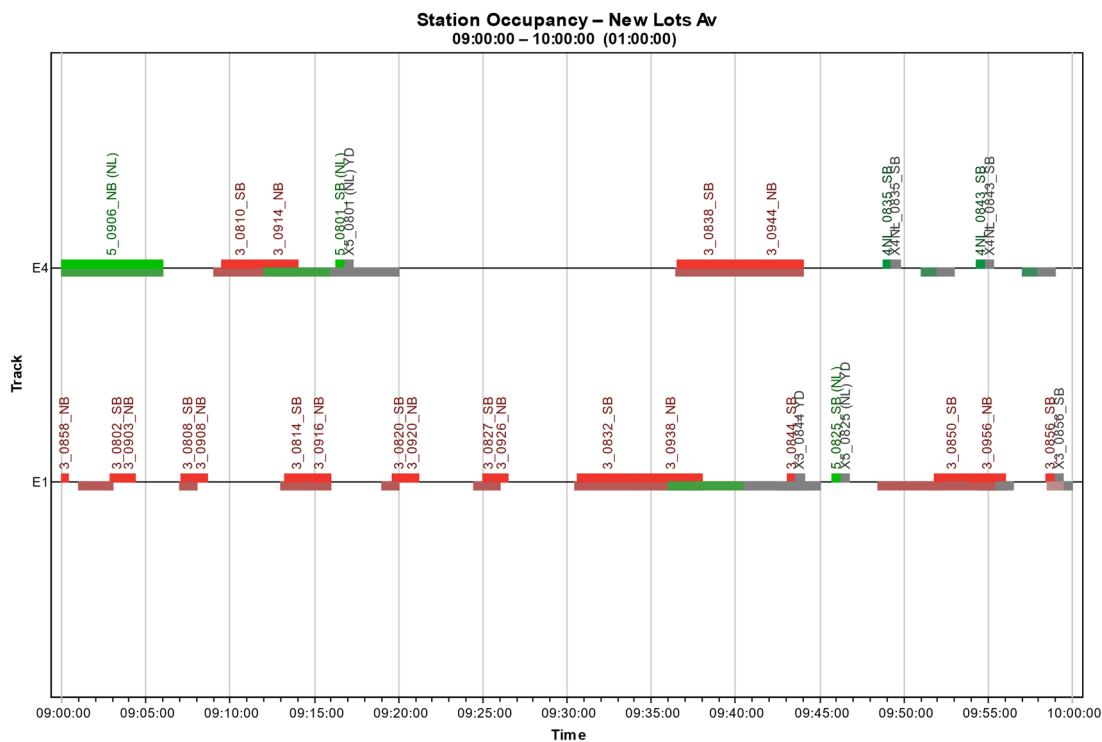


Figure G.5-4: Future Baseline (CBTC) Station Occupancy Chart - New Lots Avenue - 9:00 to 10:00 a.m.



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Figure G.5-5: Future Baseline (CBTC) Station Occupancy Chart - New Lots Avenue - 3:00 to 4:00 p.m.

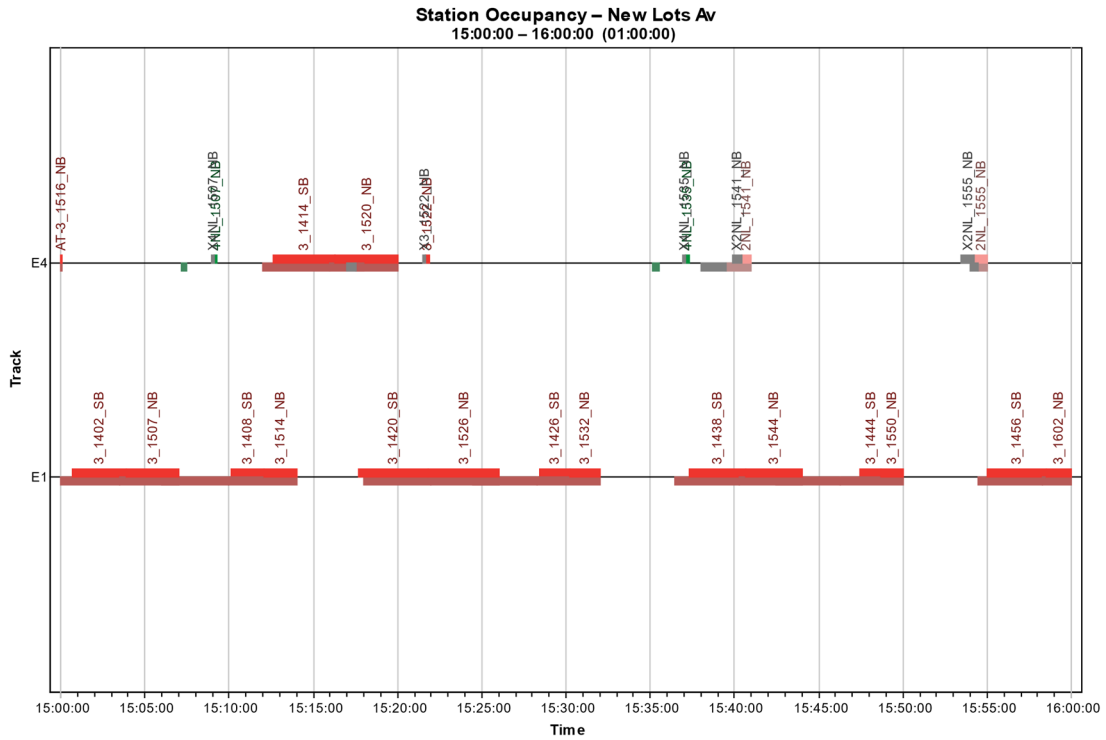
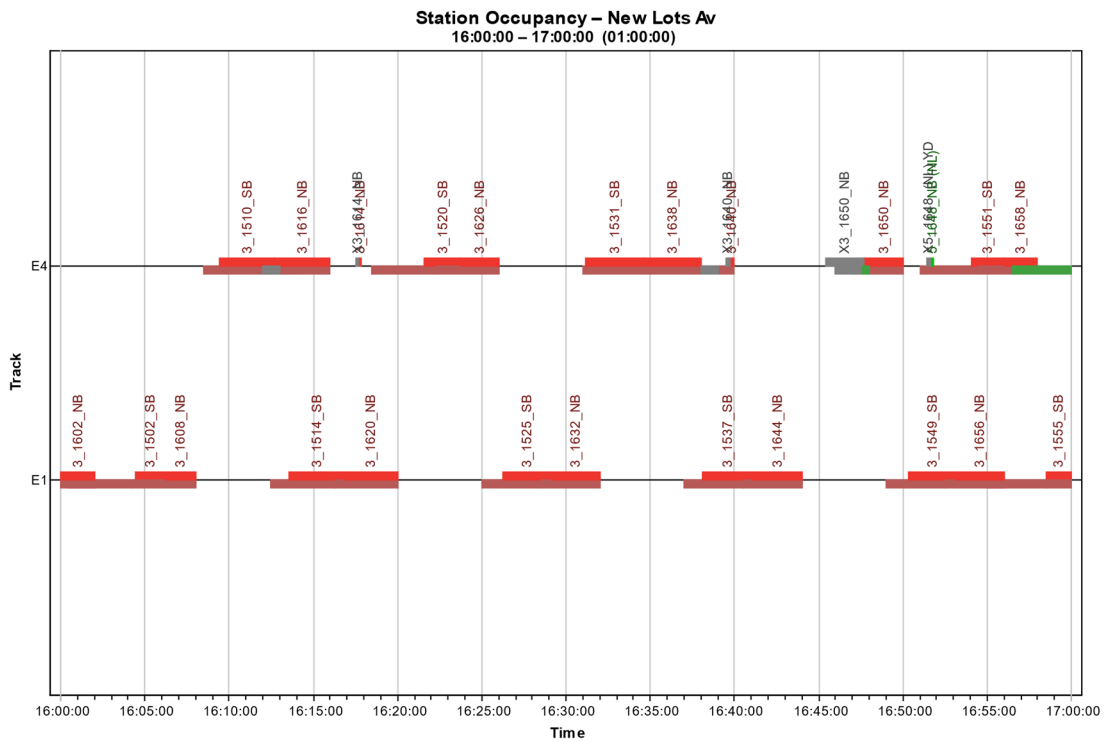


Figure G.5-6: Future Baseline (CBTC) Station Occupancy Chart - New Lots Avenue - 4:00 to 5:00 p.m.



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Figure G.5-7: Future Baseline (CBTC) Station Occupancy Chart - New Lots Avenue - 5:00 to 6:00 p.m.

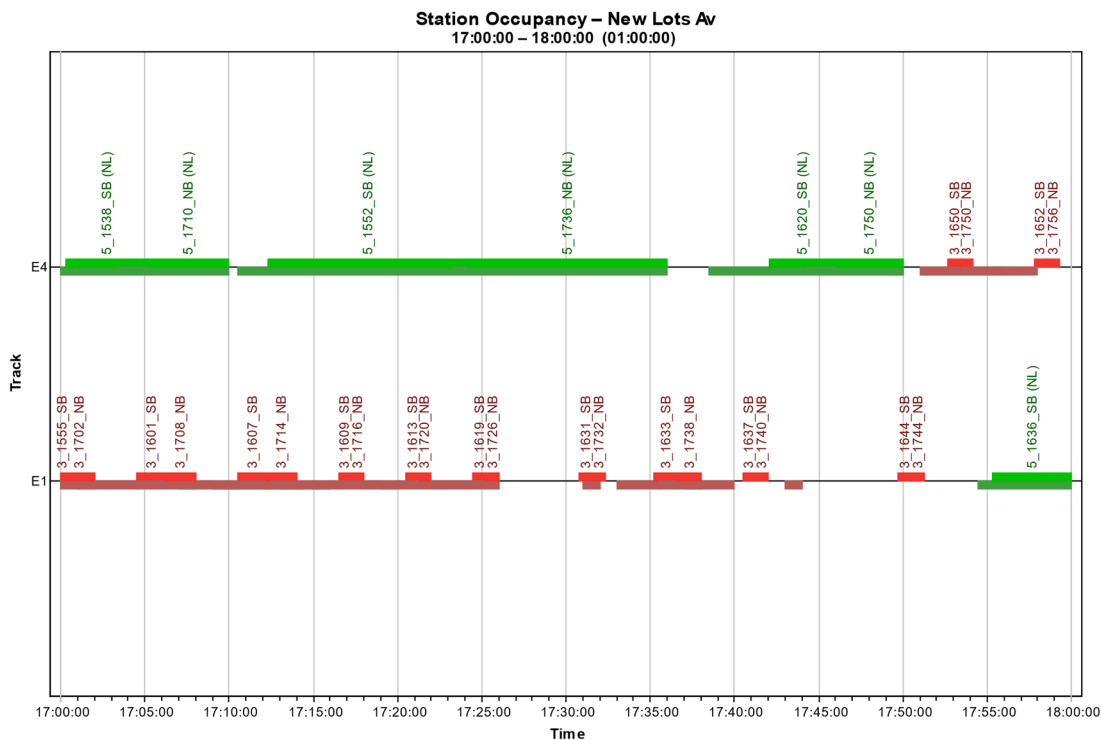
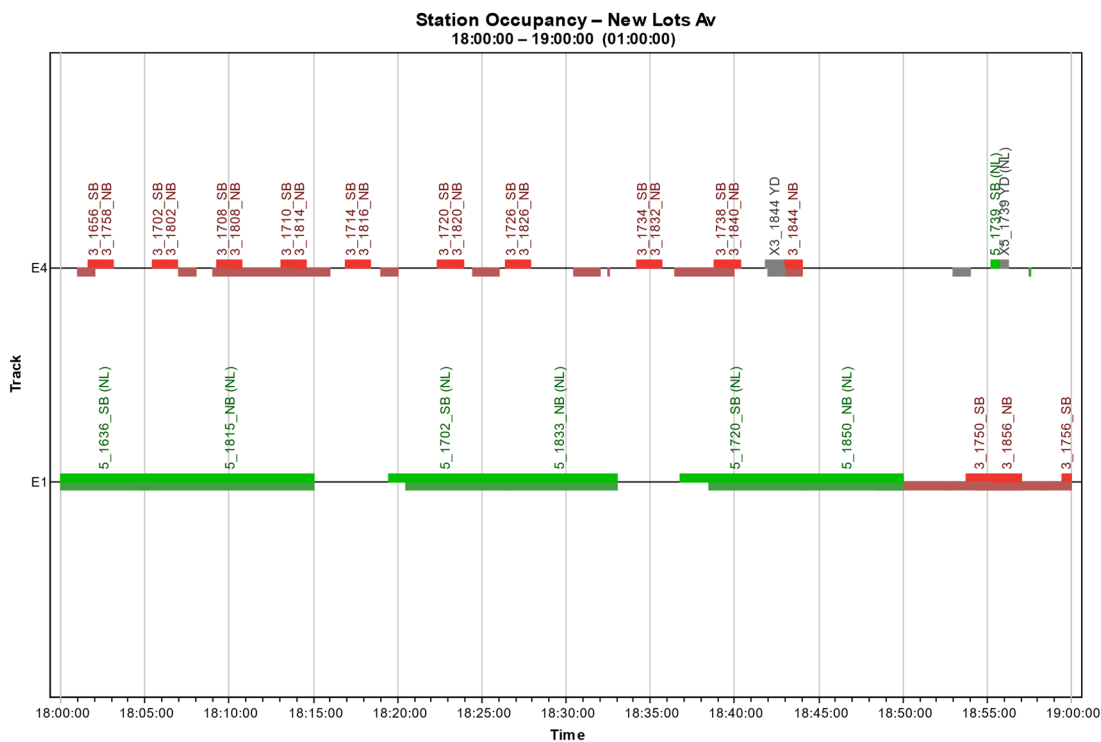


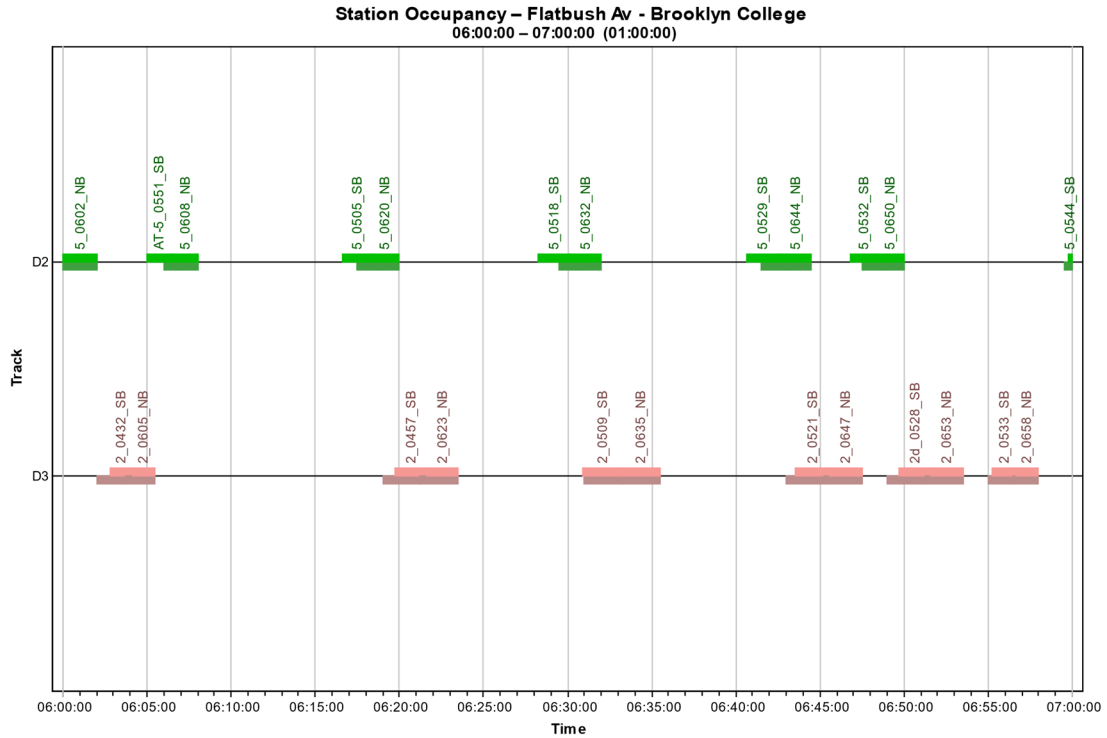
Figure G.5-8: Future Baseline (CBTC) Station Occupancy Chart - New Lots Avenue - 6:00 to 7:00 p.m.



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G.5.2 Flatbush Avenue/Brooklyn College

Figure G.5-9: Future Baseline (CBTC) Station Occupancy Chart - Flatbush Avenue /Brooklyn College - 6:00 to 7:00 a.m.



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Figure G.5-10: Future Baseline (CBTC) Station Occupancy Chart - Flatbush Avenue /Brooklyn College - 7:00 to 8:00 a.m.

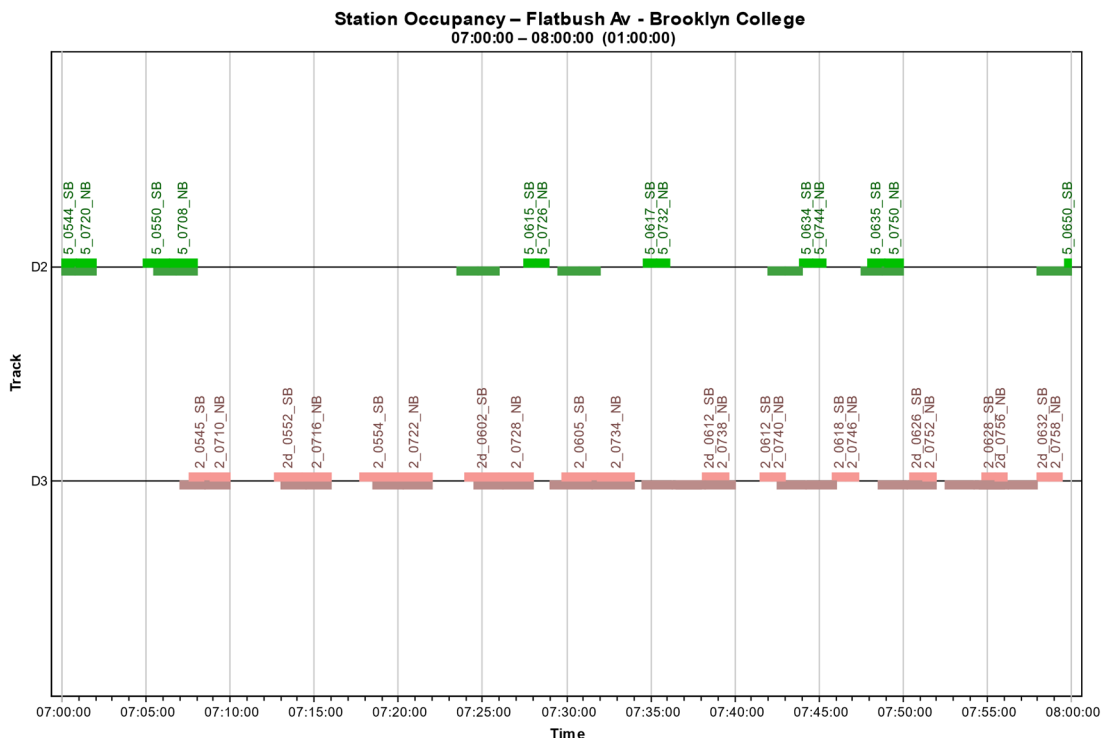
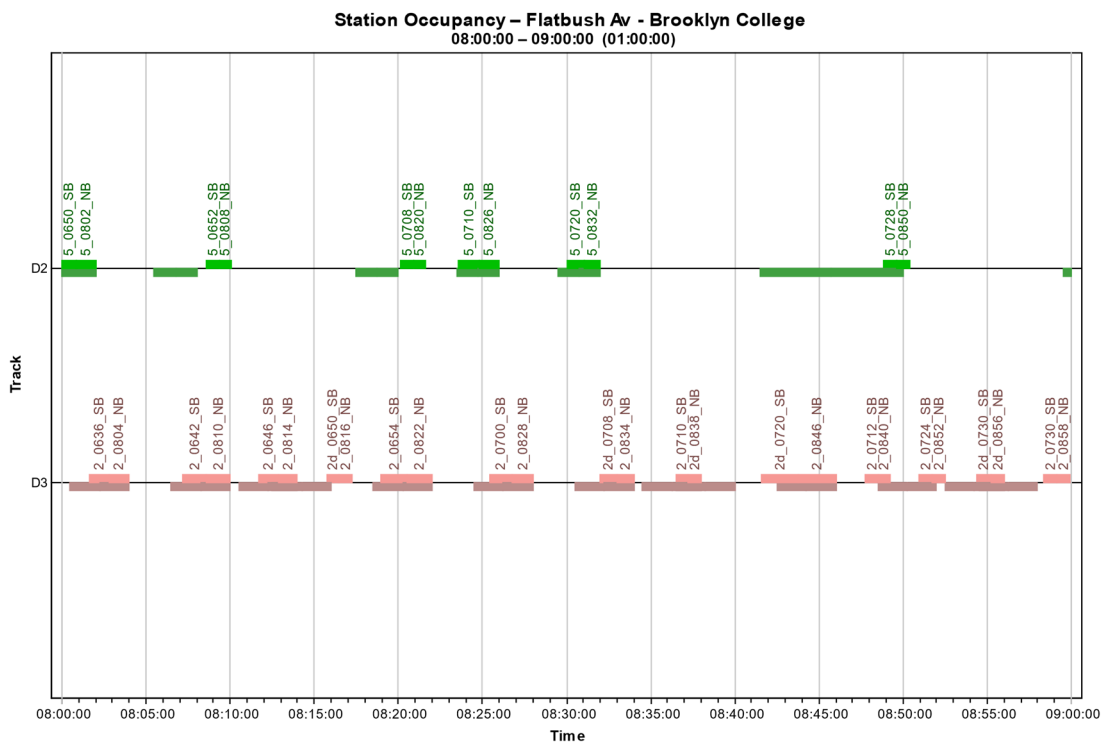


Figure G.5-11: Future Baseline (CBTC) Station Occupancy Chart - Flatbush Avenue /Brooklyn College - 8:00 to 9:00 a.m.



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Figure G.5-12: Future Baseline (CBTC) Station Occupancy Chart - Flatbush Avenue /Brooklyn College - 9:00 to 10:00 a.m.

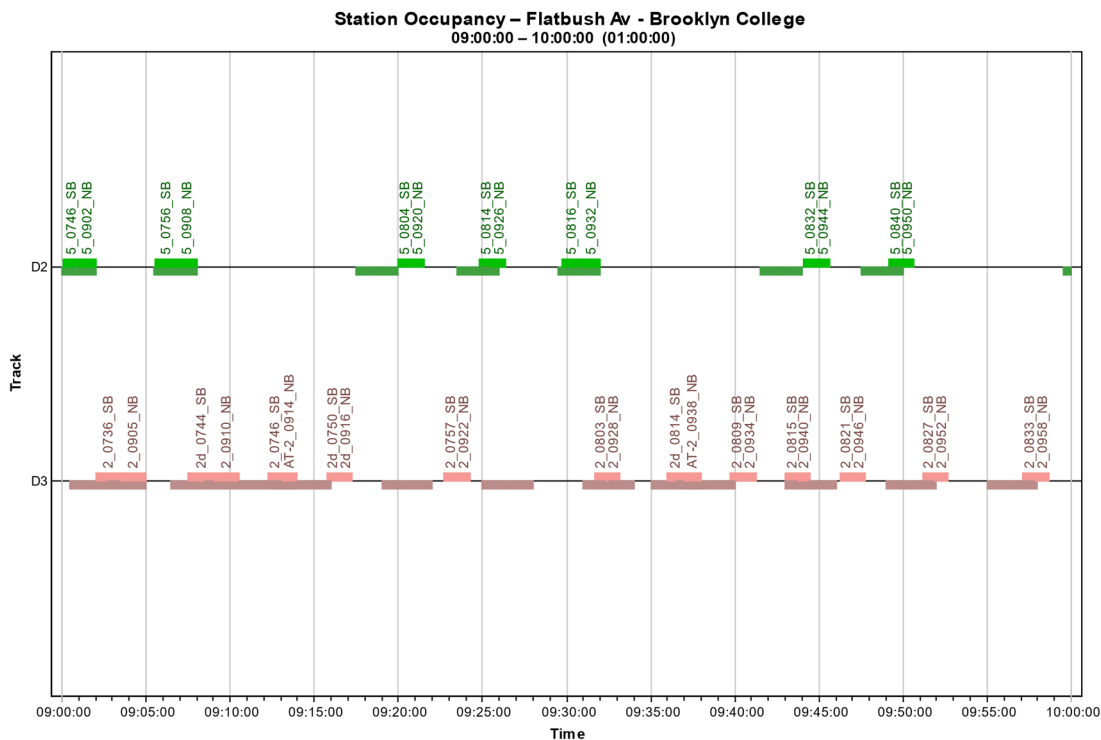
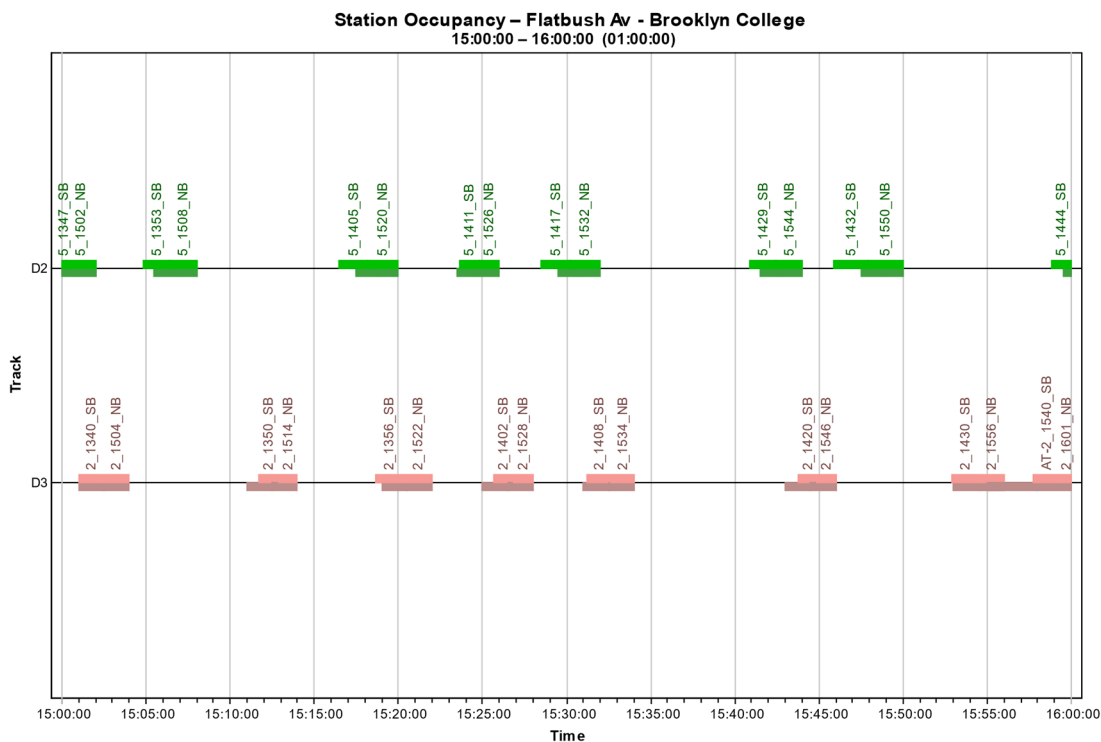


Figure G.5-13: Future Baseline (CBTC) Station Occupancy Chart - Flatbush Avenue /Brooklyn College - 3:00 to 4:00 p.m.



APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.5-14: Future Baseline (CBTC) Station Occupancy Chart - Flatbush Avenue /Brooklyn College -
4:00 to 5:00 p.m.

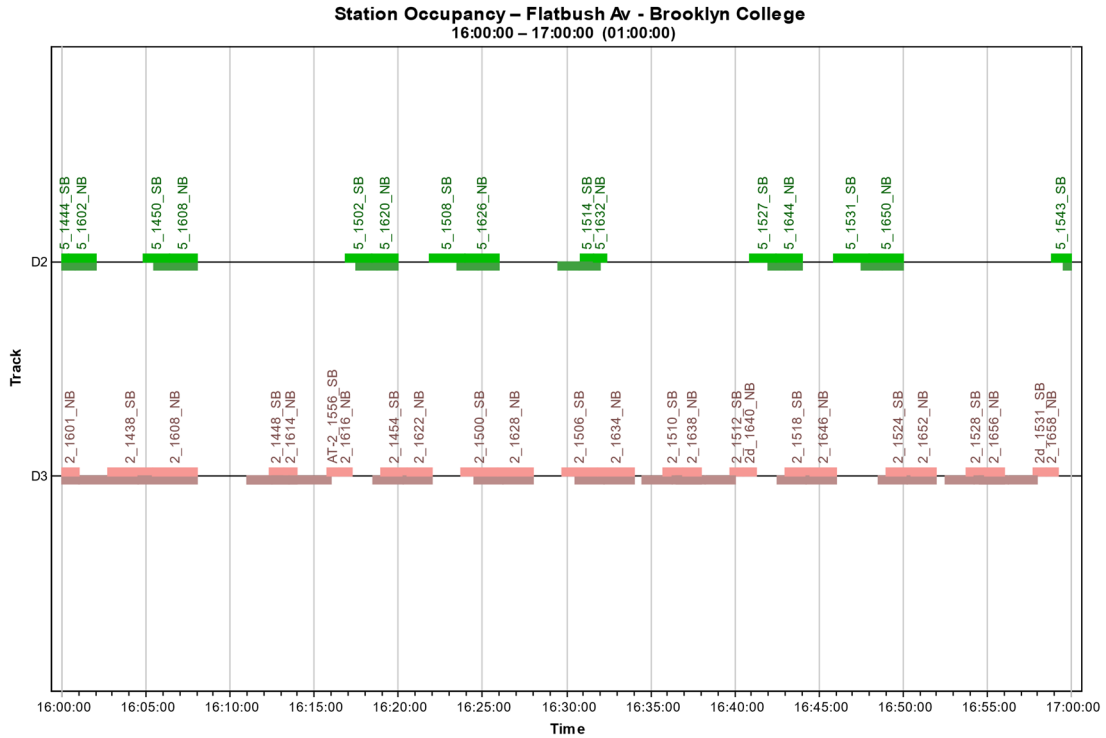
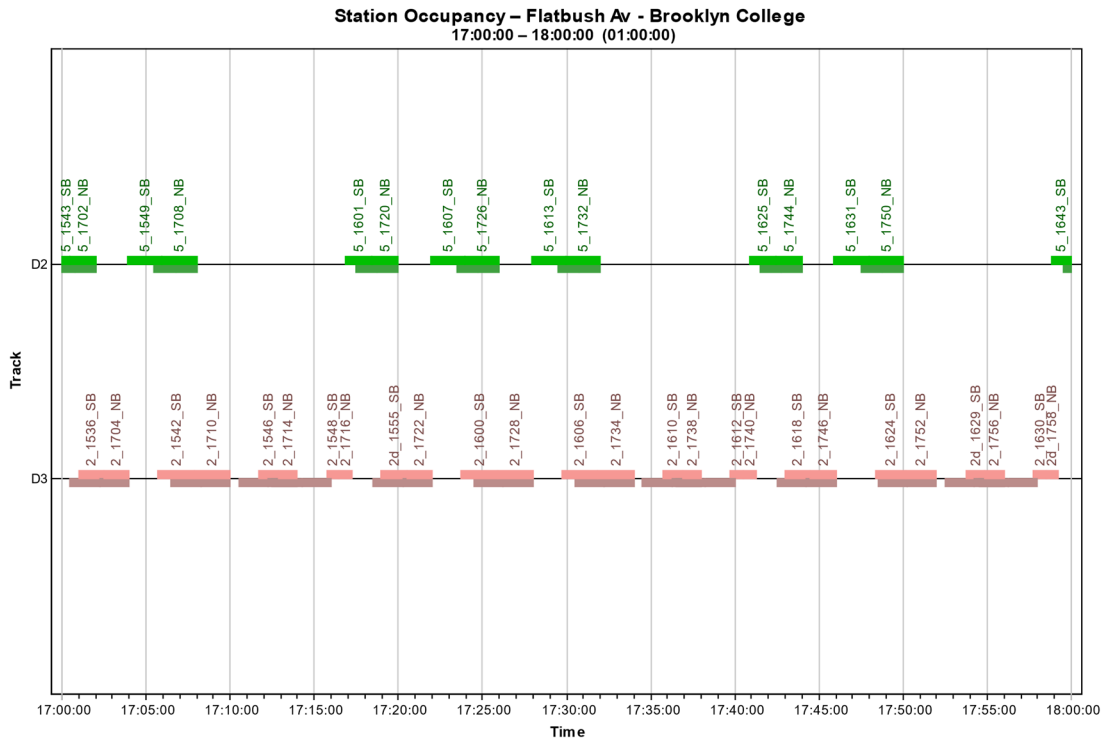
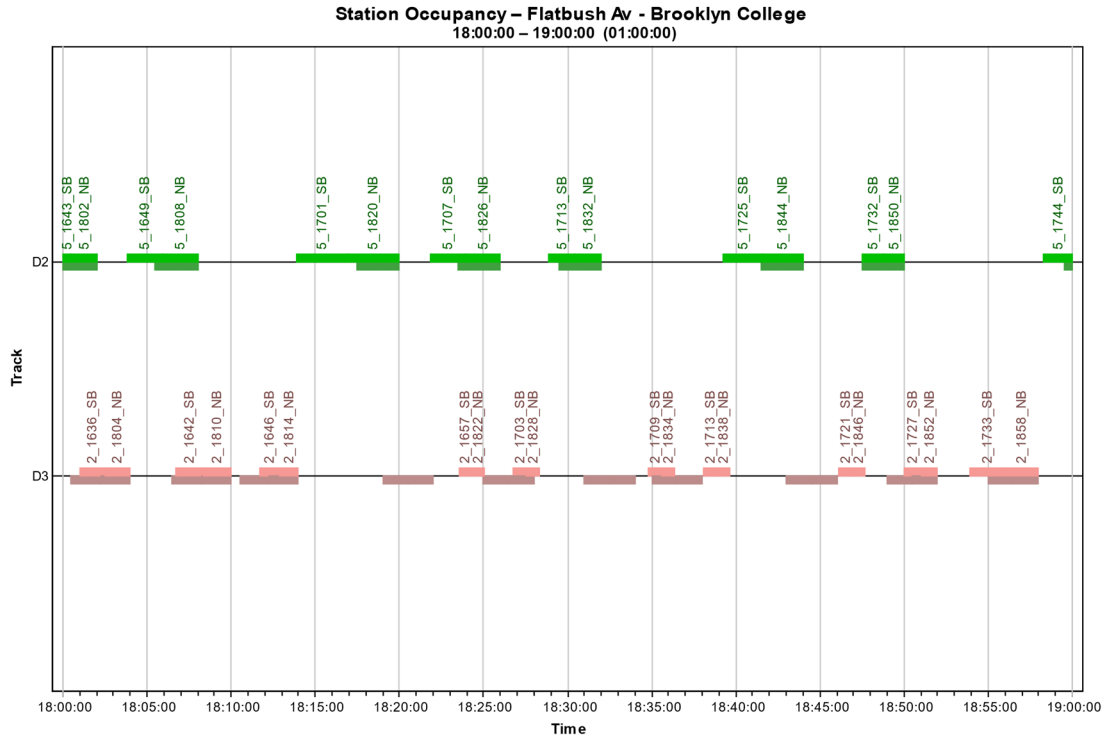


Figure G.5-15: Future Baseline (CBTC) Station Occupancy Chart - Flatbush Avenue /Brooklyn College -
5:00 to 6:00 pm.



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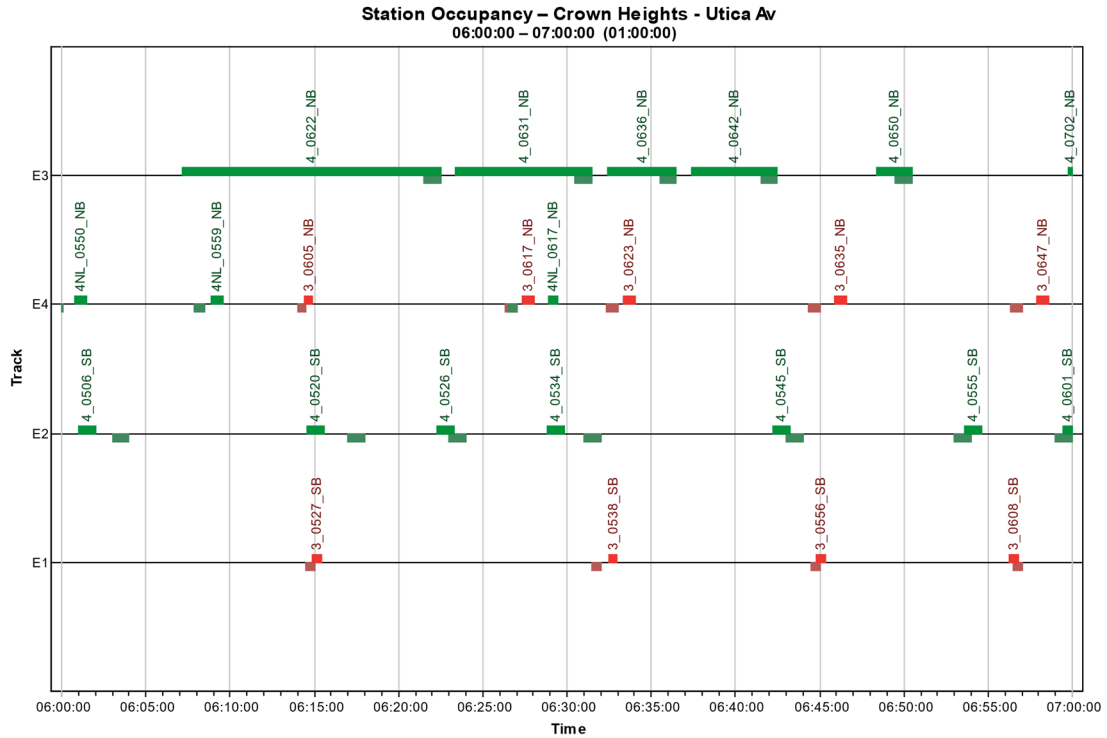
Figure G.5-16: Future Baseline (CBTC) Station Occupancy Chart - Flatbush Avenue /Brooklyn College - 6:00 to 7:00 p.m.



APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

G.5.3 Crown Heights/Utica Avenue

Figure G.5-17: Future Baseline (CBTC) Station Occupancy Chart - Crown Heights/Utica Avenue - 6:00 to 7:00 a.m.



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Figure G.5-18: Future Baseline (CBTC) Station Occupancy Chart - Crown Heights/Utica Avenue - 7:00 to 8:00 a.m.

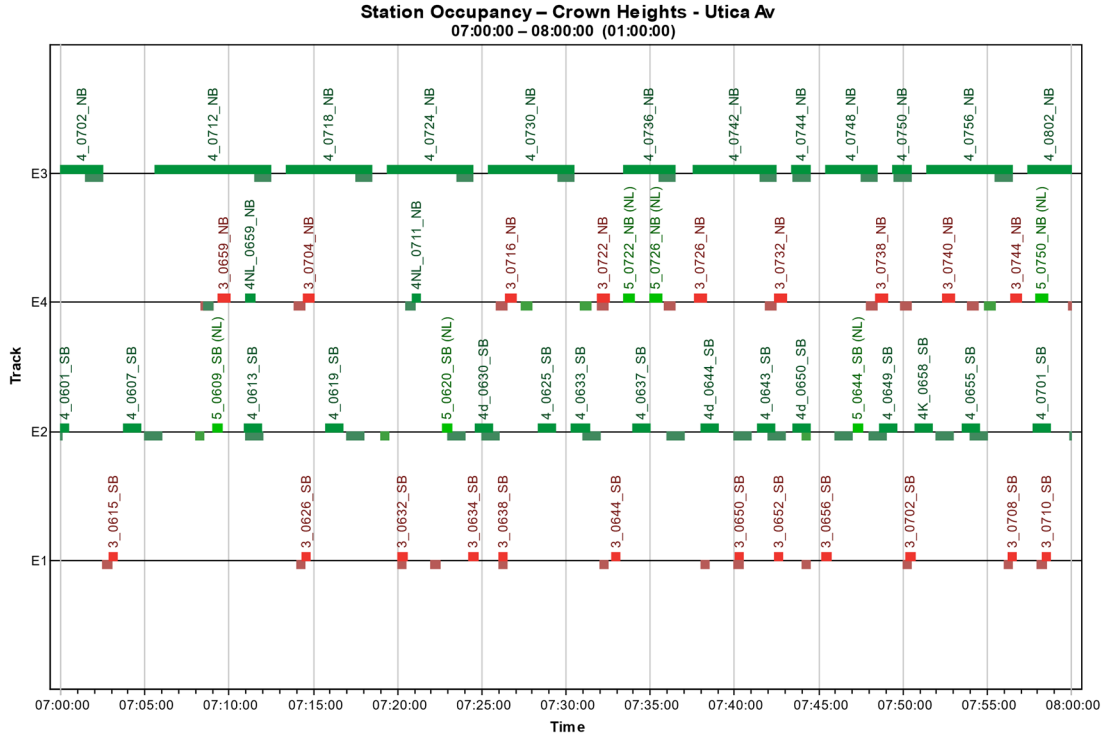
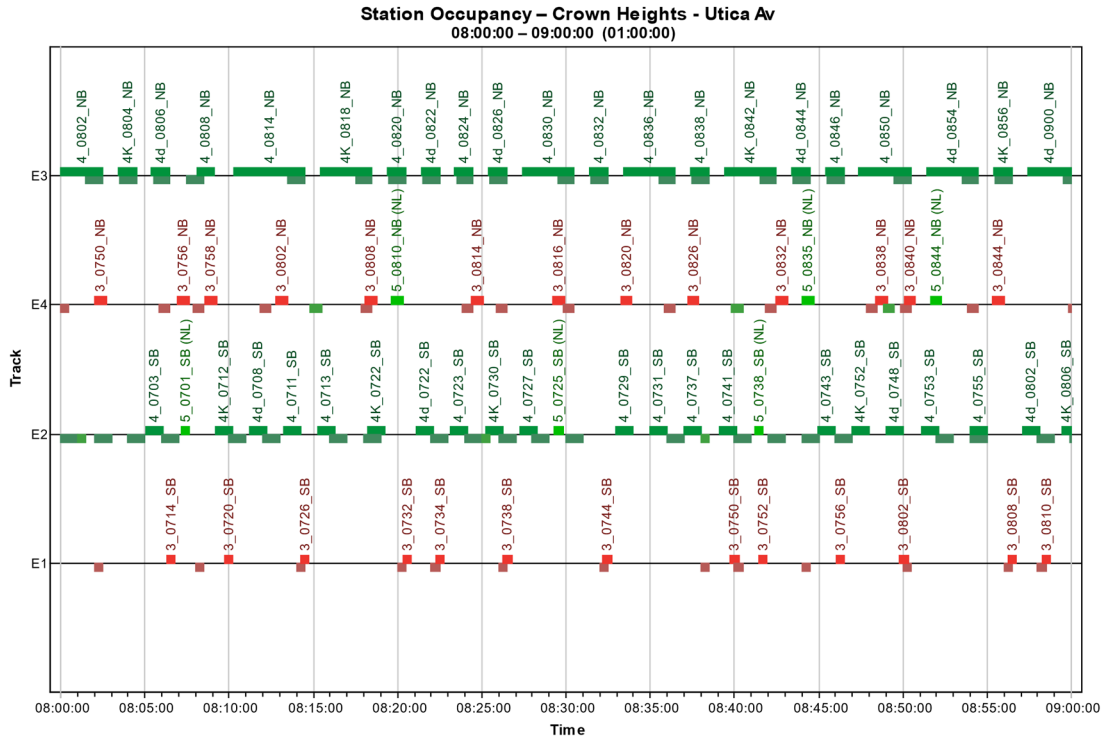


Figure G.5-19: Future Baseline (CBTC) Station Occupancy Chart - Crown Heights/Utica Avenue - 8:00 to 9:00 a.m.



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Figure G.5-20: Future Baseline (CBTC) Station Occupancy Chart - Crown Heights/Utica Avenue - 9:00 to 10:00 a.m.

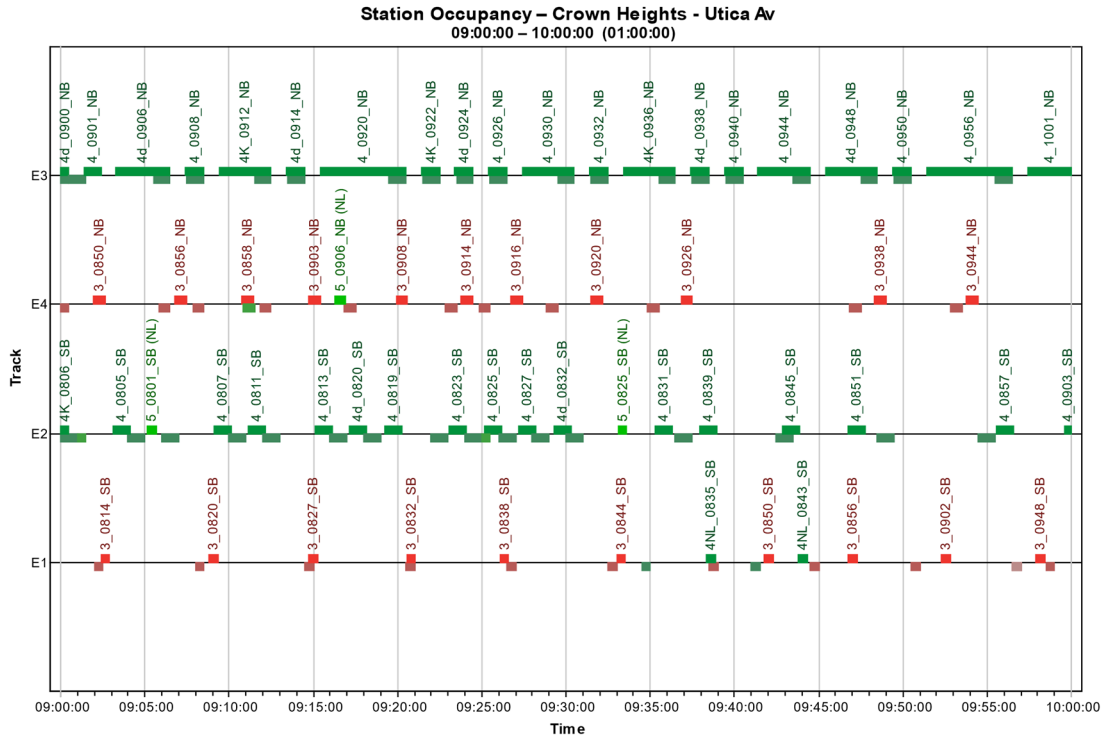
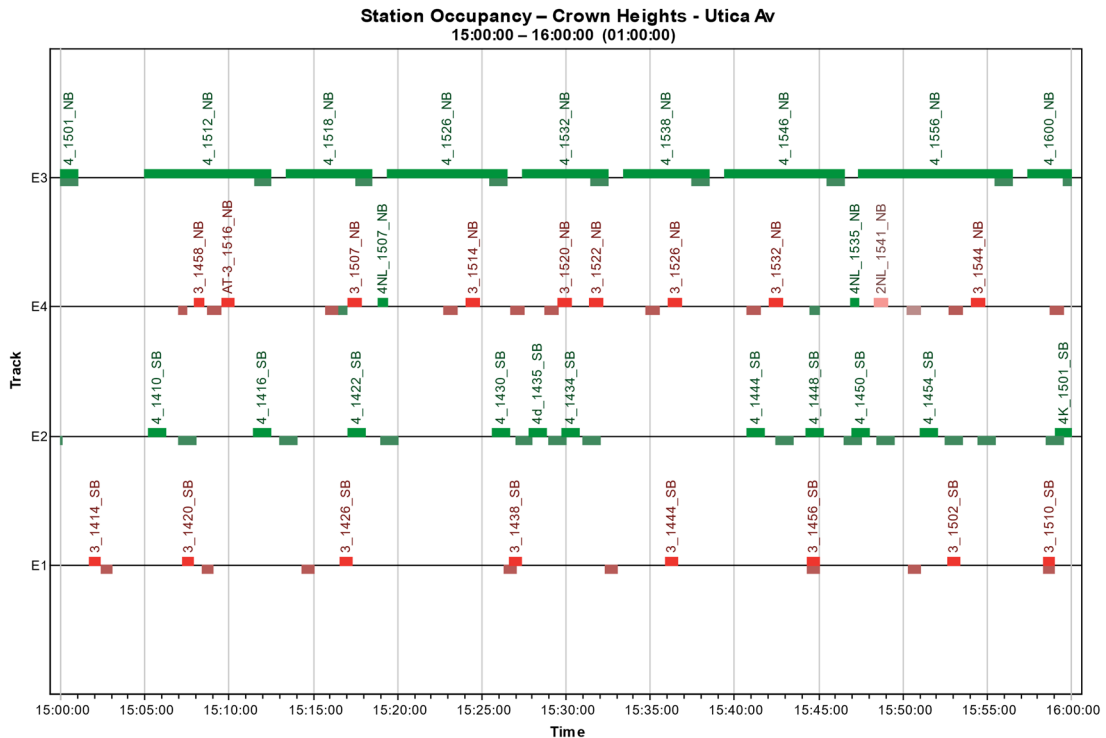


Figure G.5-21: Future Baseline (CBTC) Station Occupancy Chart - Crown Heights/Utica Avenue - 3:00 to 4:00 p.m.



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Figure G.5-22: Future Baseline (CBTC) Station Occupancy Chart - Crown Heights/Utica Avenue - 4:00 to 5:00 p.m.

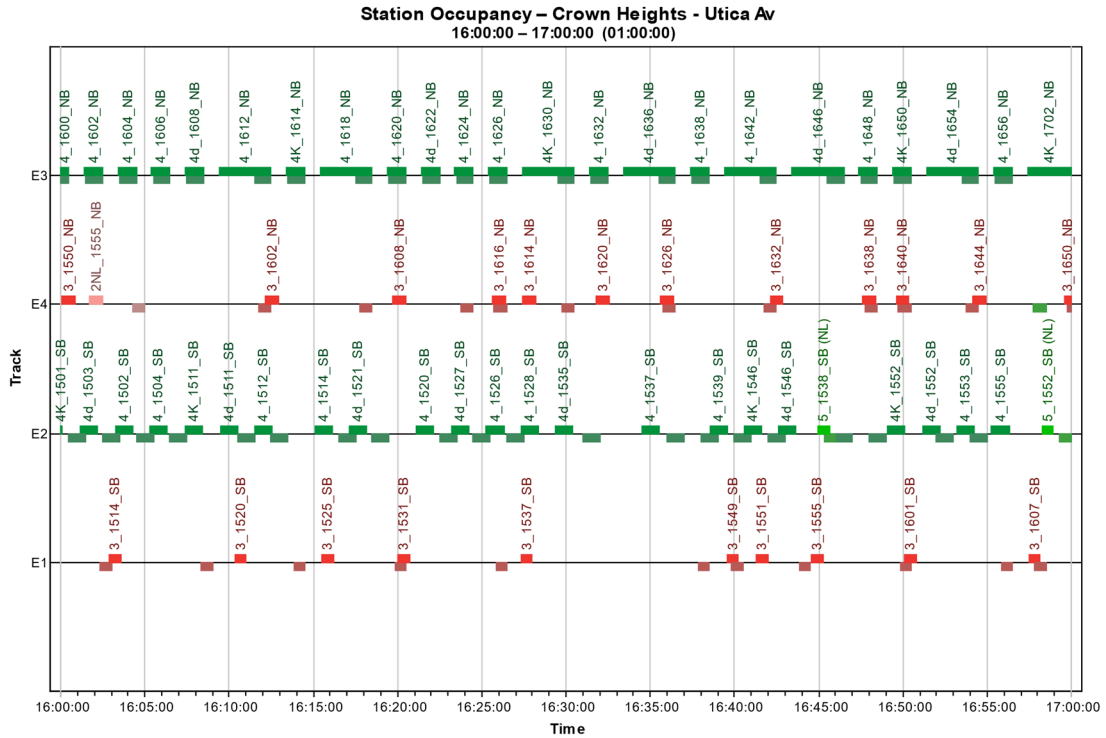
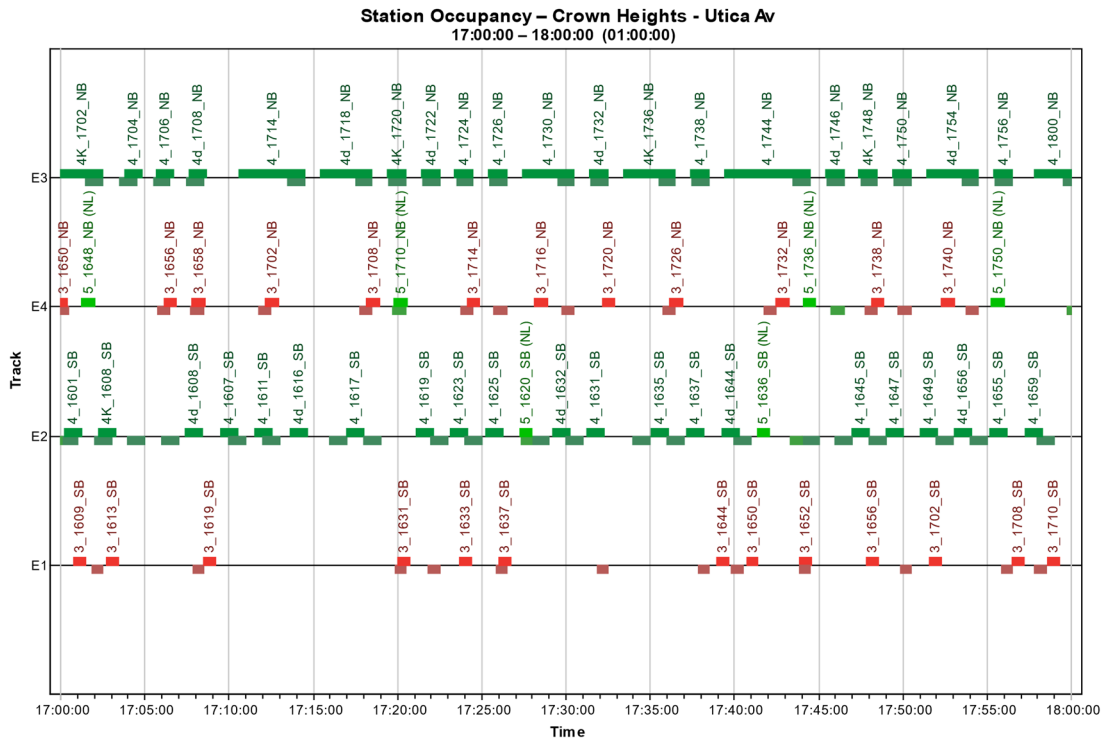
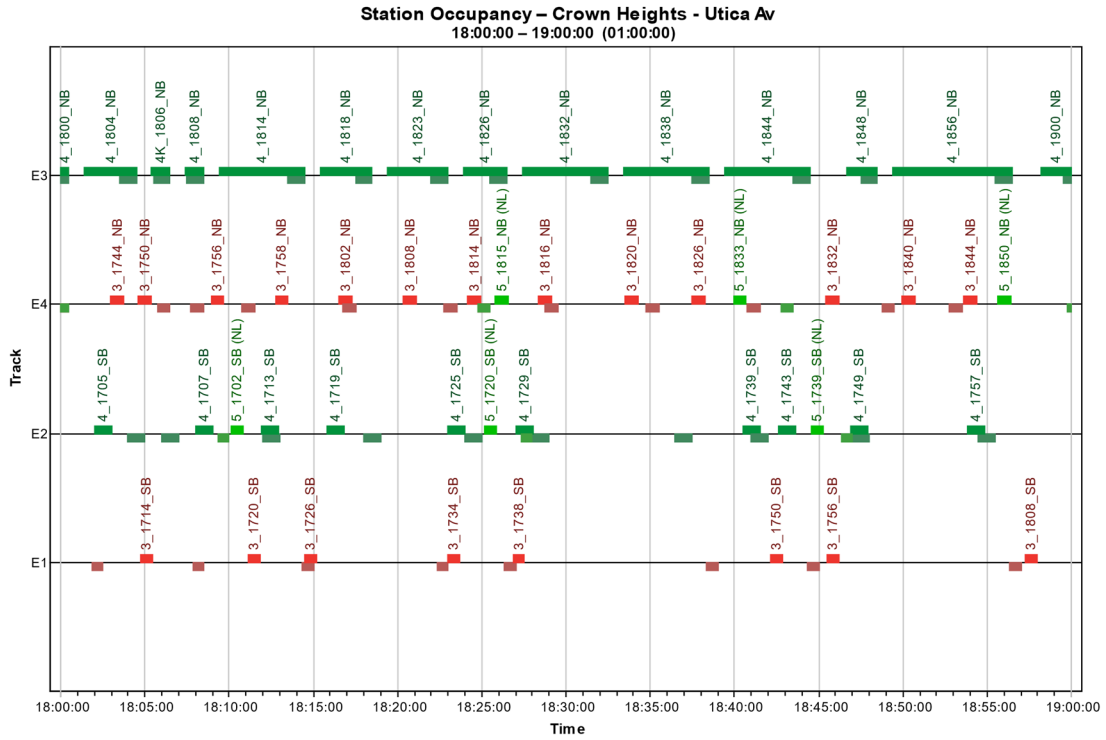


Figure G.5-23: Future Baseline (CBTC) Station Occupancy Chart - Crown Heights/Utica Avenue - 5:00 to 6:00 p.m.



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Figure G.5-24: Future Baseline (CBTC) Station Occupancy Chart - Crown Heights/Utica Avenue - 6:00 to 7:00 p.m.



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G.5.4 Brooklyn Bridge

Figure G.5-25: Future Baseline (CBTC) Station Occupancy Chart - Brooklyn Bridge - 6:00 to 7:00 a.m.

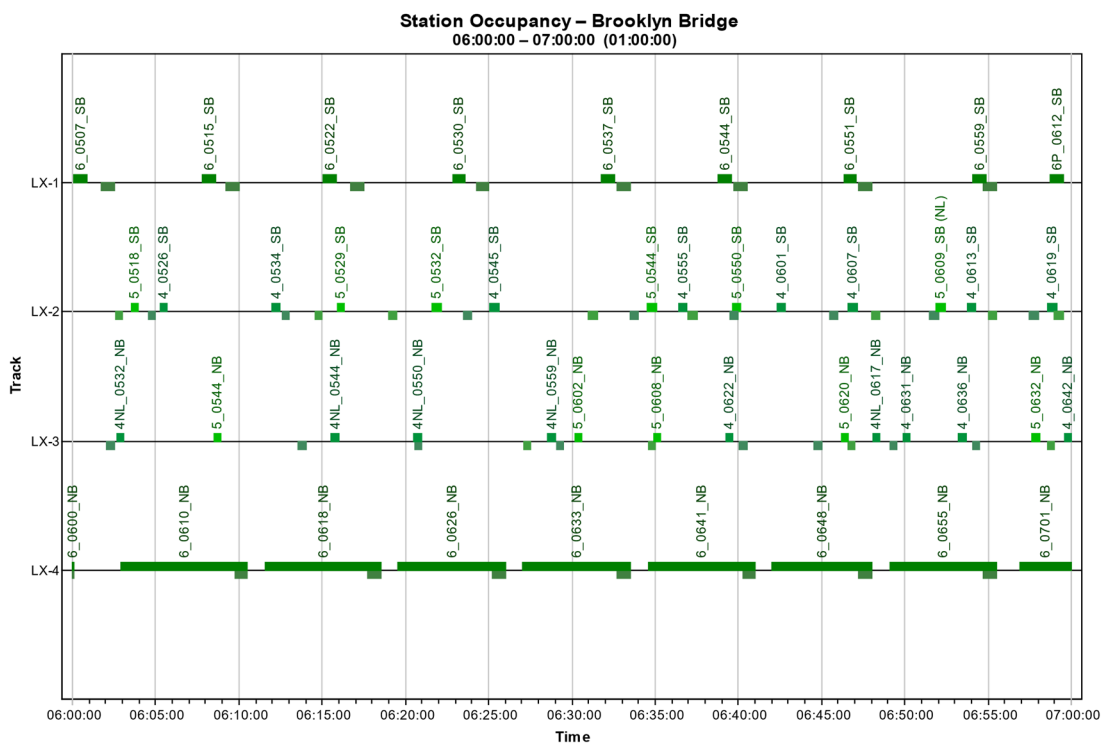
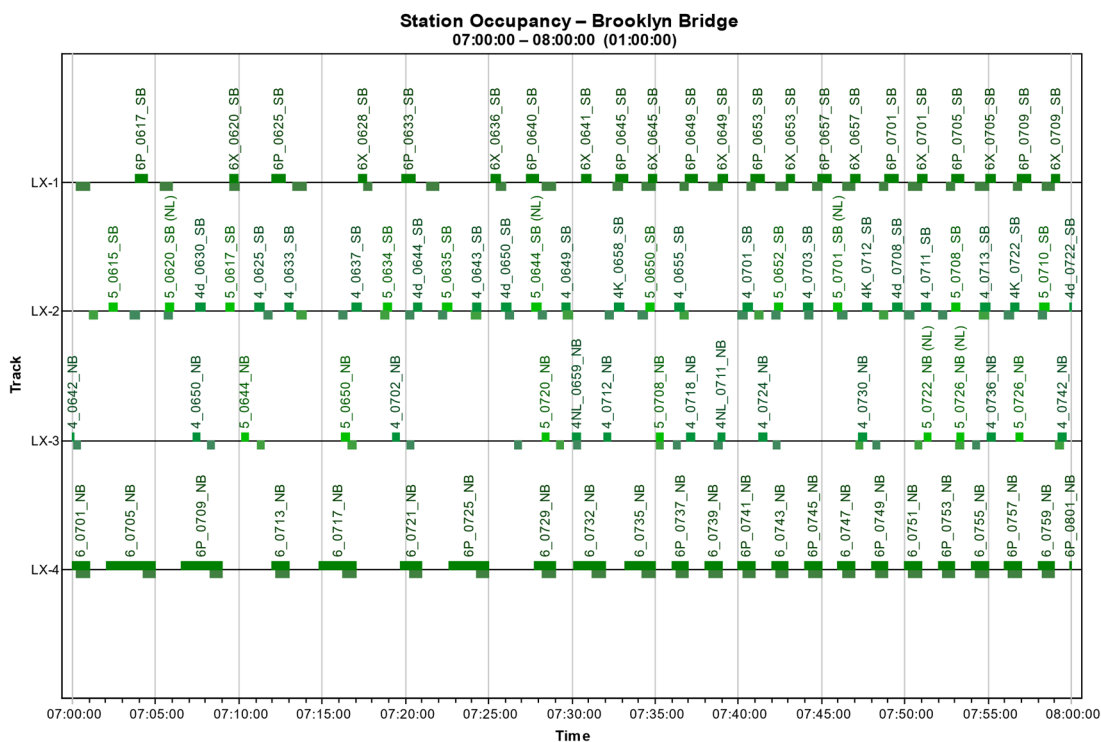


Figure G.5-26: Future Baseline (CBTC) Station Occupancy Chart - Brooklyn Bridge - 7:00 to 8:00 a.m.



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Figure G.5-27: Future Baseline (CBTC) Station Occupancy Chart - Brooklyn Bridge - 8:00 to 9:00 a.m.

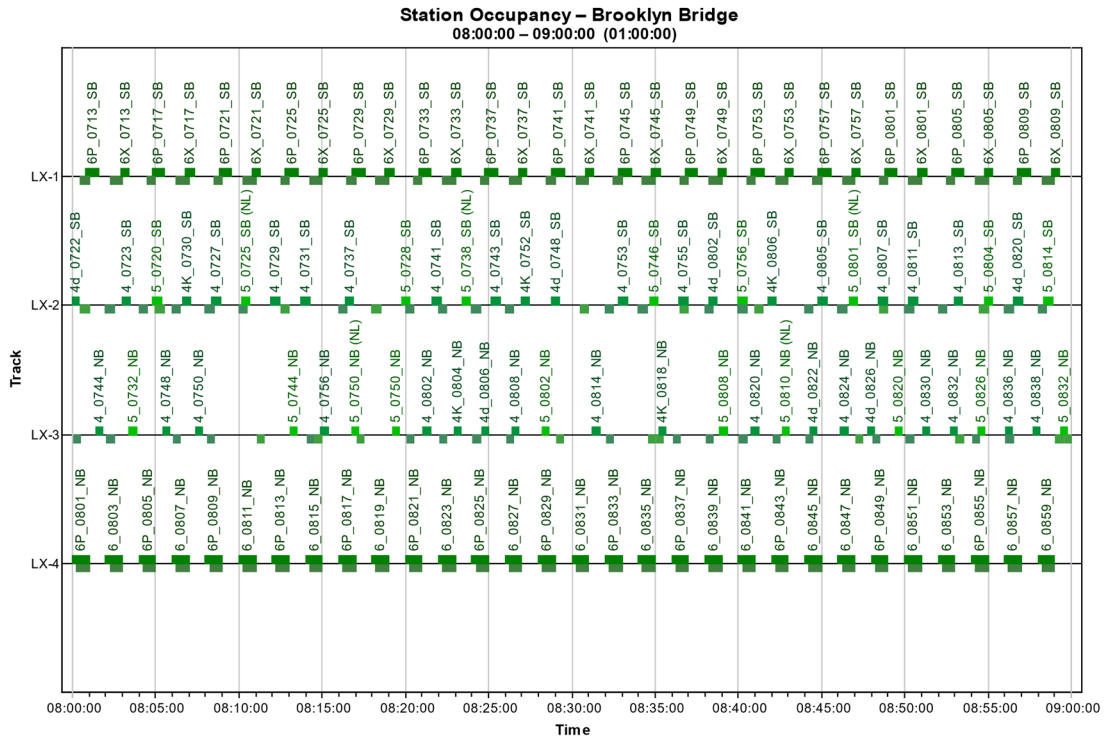
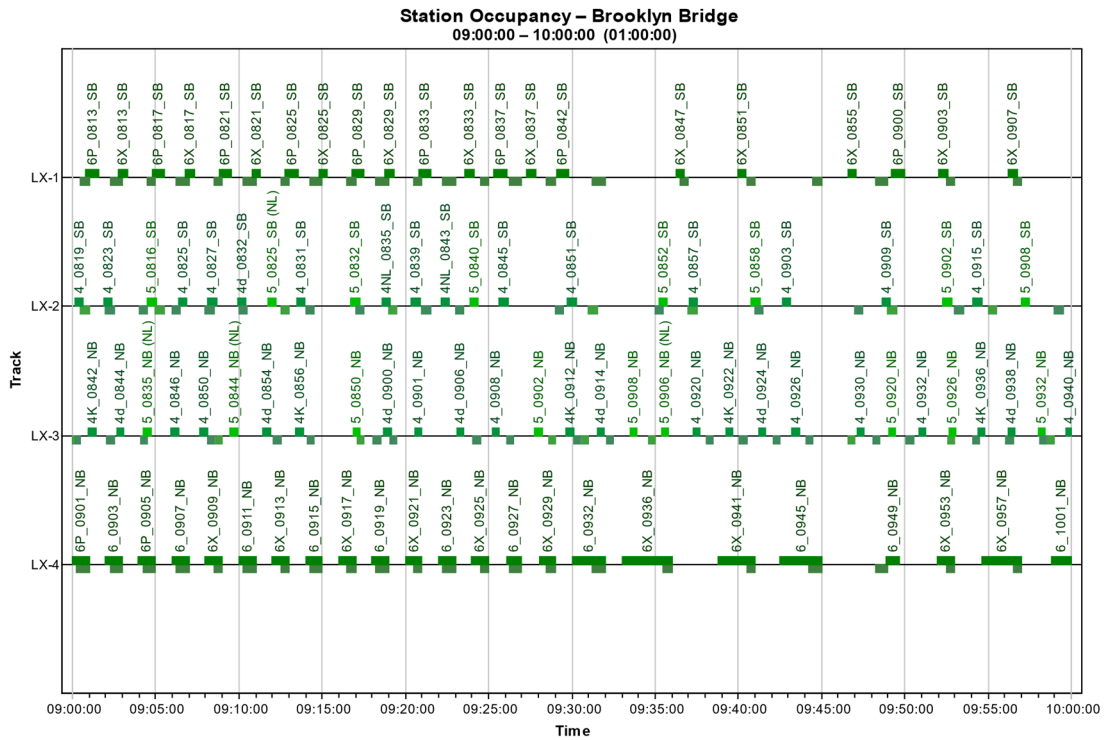


Figure G.5-28: Future Baseline (CBTC) Station Occupancy Chart - Brooklyn Bridge - 9:00 to 10:00 a.m.



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Figure G.5-31: Future Baseline (CBTC) Station Occupancy Chart - Brooklyn Bridge - 5:00 to 6:00 p.m.

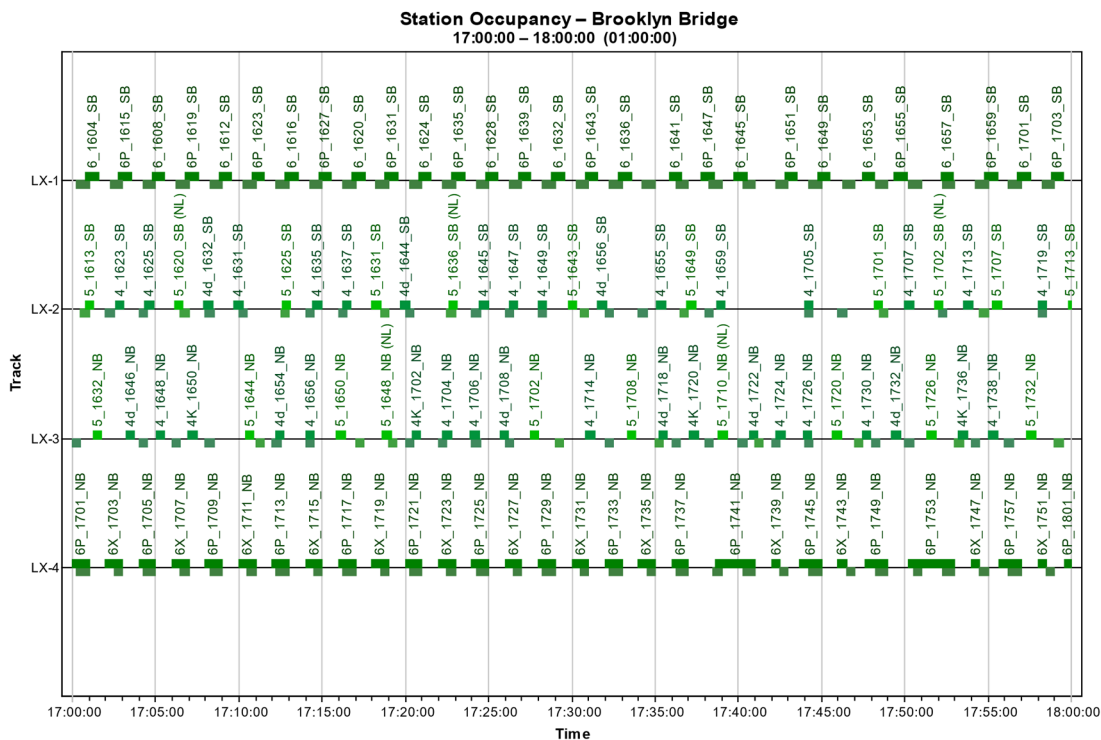
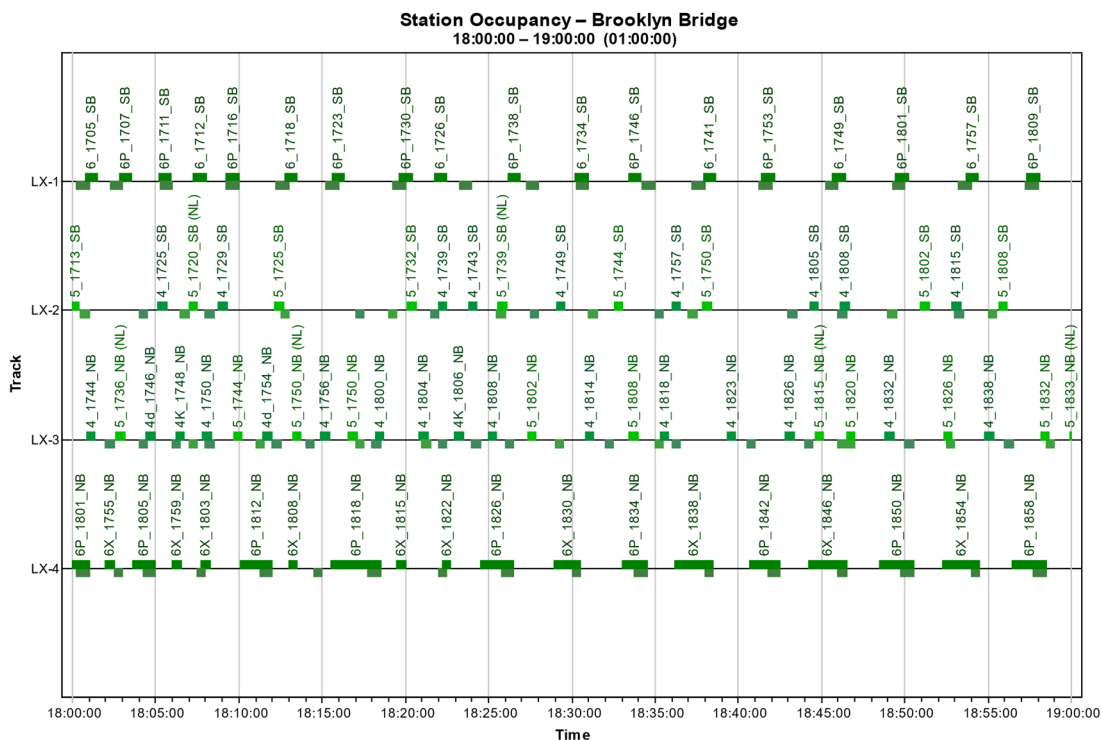


Figure G.5-32: Future Baseline (CBTC) Station Occupancy Chart - Brooklyn Bridge - 6:00 to 7:00 p.m.



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G.5.5 Pelham Bay Park

Figure G.5-33: Future Baseline (CBTC) Station Occupancy Chart – Pelham Bay Park – 6:00 to 7:00 a.m.

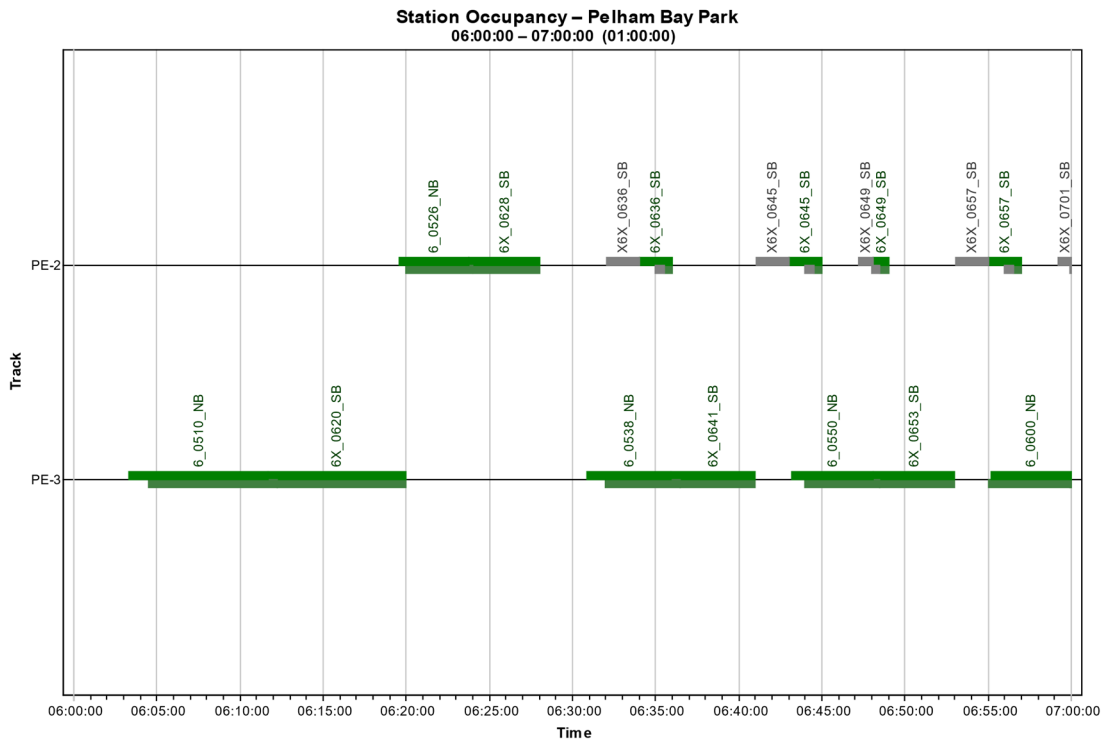
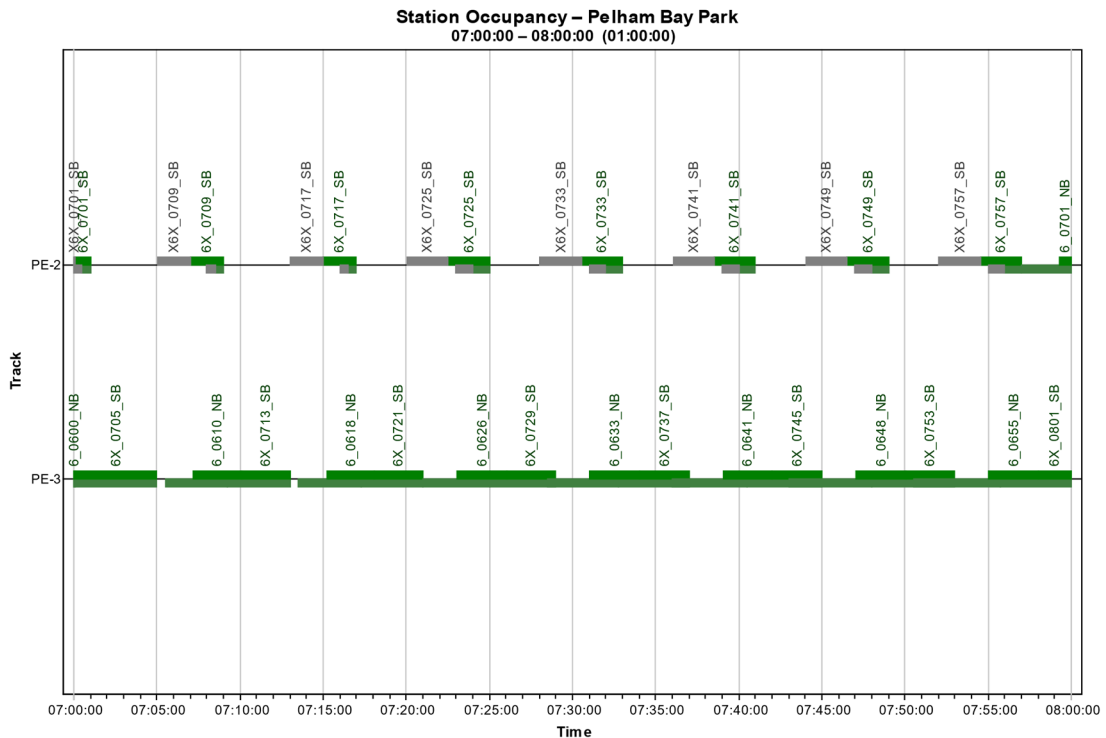


Figure G.5-34: Future Baseline (CBTC) Station Occupancy Chart – Pelham Bay Park – 7:00 to 8:00 a.m.



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Figure G.5-35: Future Baseline (CBTC) Station Occupancy Chart – Pelham Bay Park – 8:00 to 9:00 a.m.

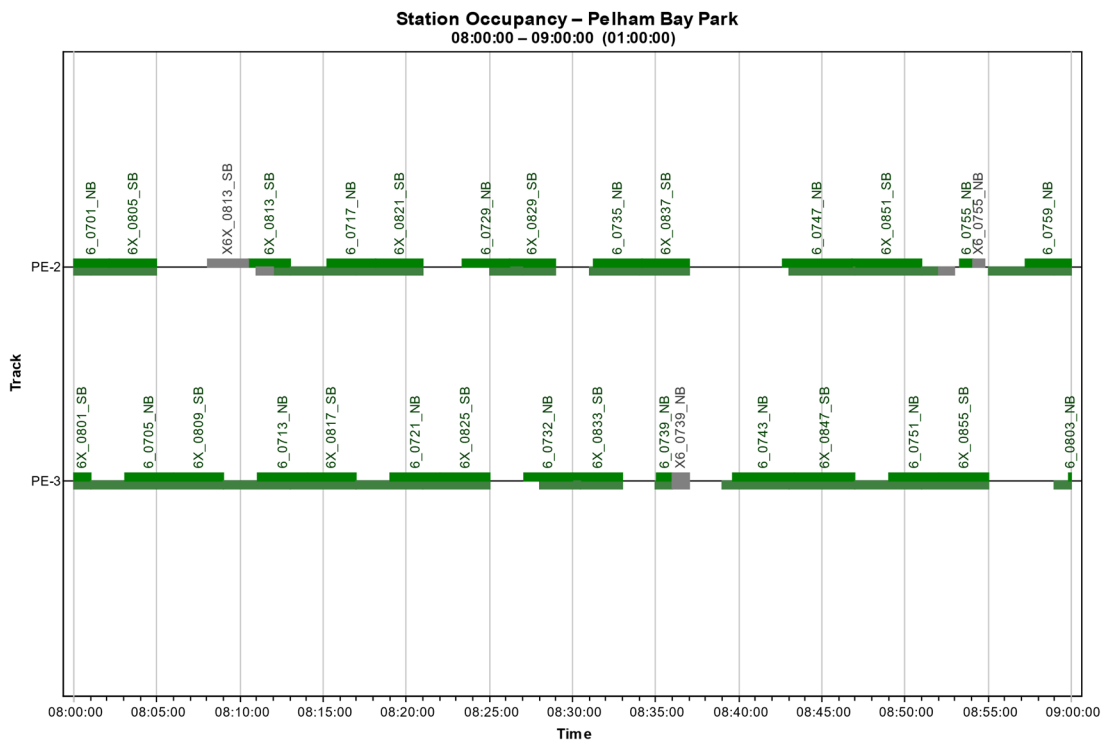
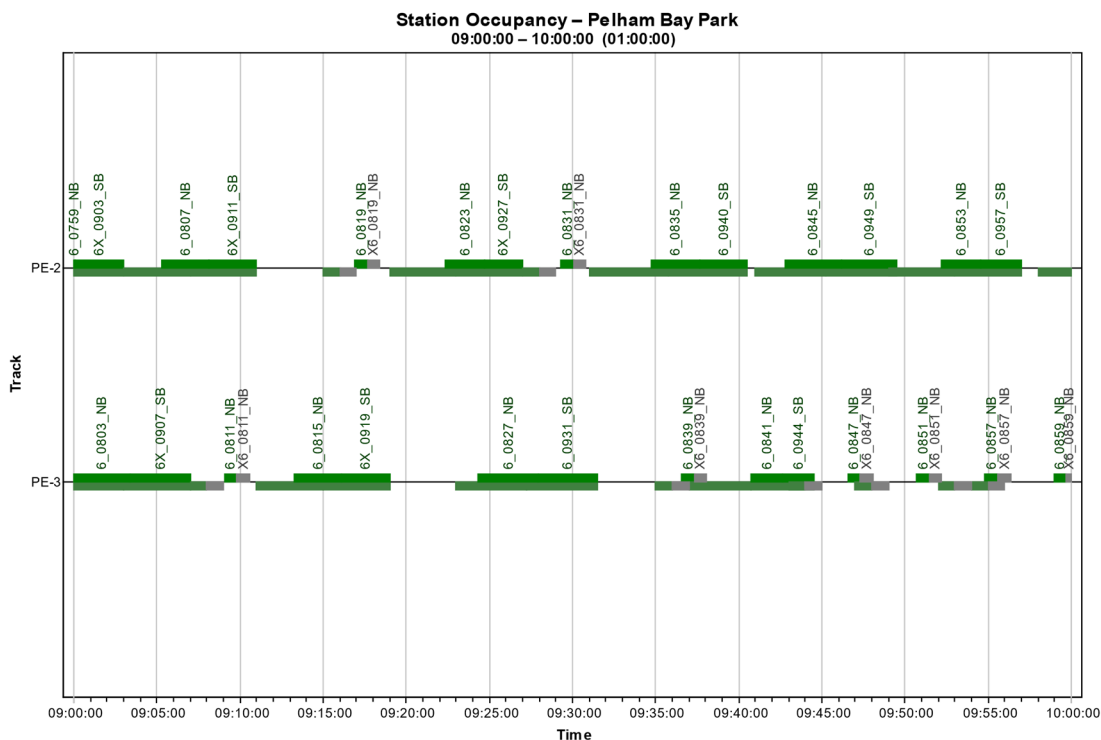


Figure G.5-36: Future Baseline (CBTC) Station Occupancy Chart – Pelham Bay Park – 9:00 to 10:00 a.m.



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Figure G.5-37: Future Baseline (CBTC) Station Occupancy Chart – Pelham Bay Park – 3:00 to 4:00 p.m.

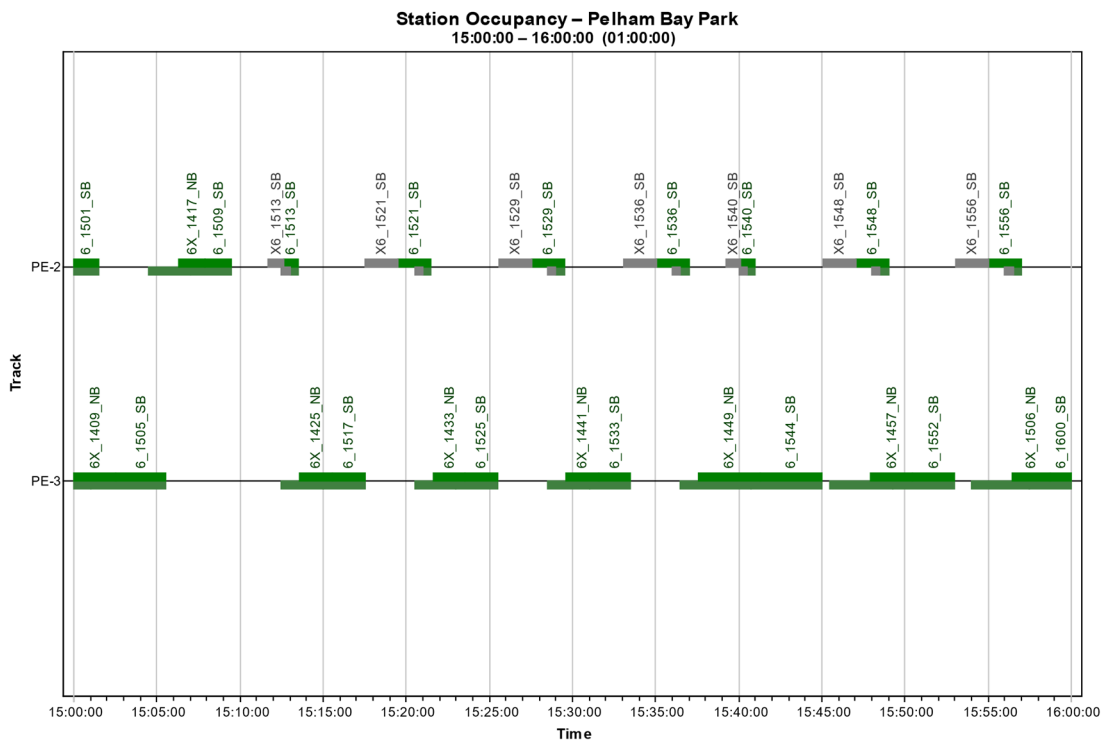
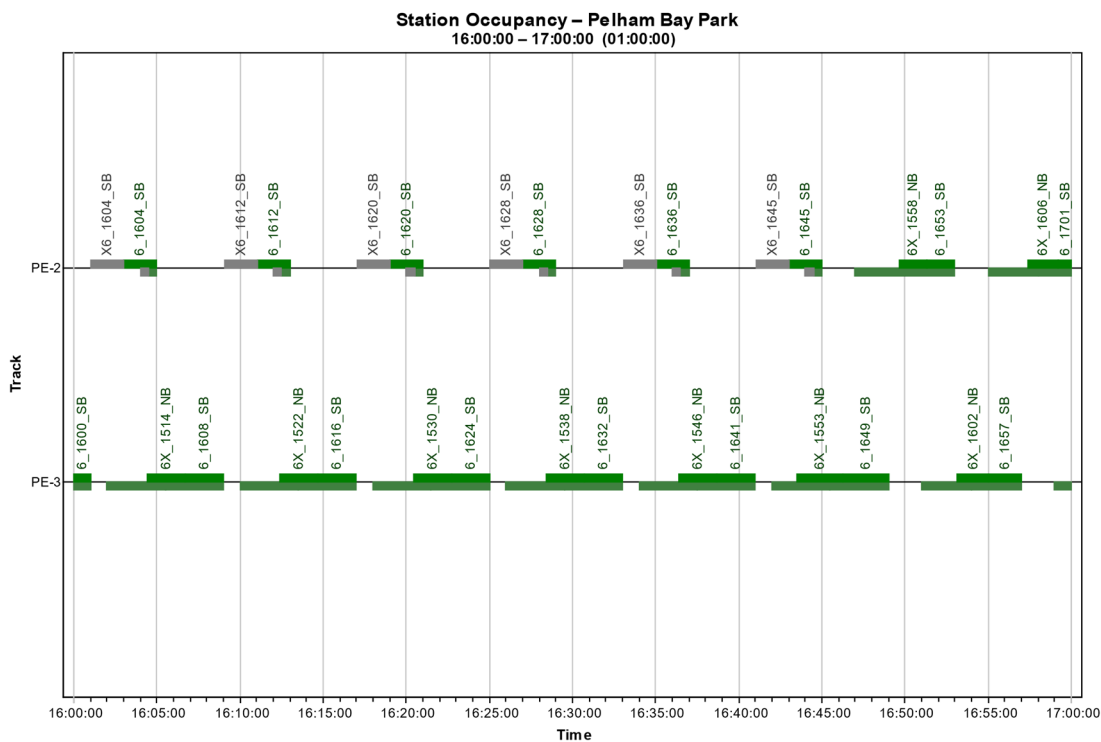


Figure G.5-38: Future Baseline (CBTC) Station Occupancy Chart – Pelham Bay Park – 4:00 to 5:00 p.m.



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Figure G.5-39: Future Baseline (CBTC) Station Occupancy Chart – Pelham Bay Park – 5:00 to 6:00 p.m.

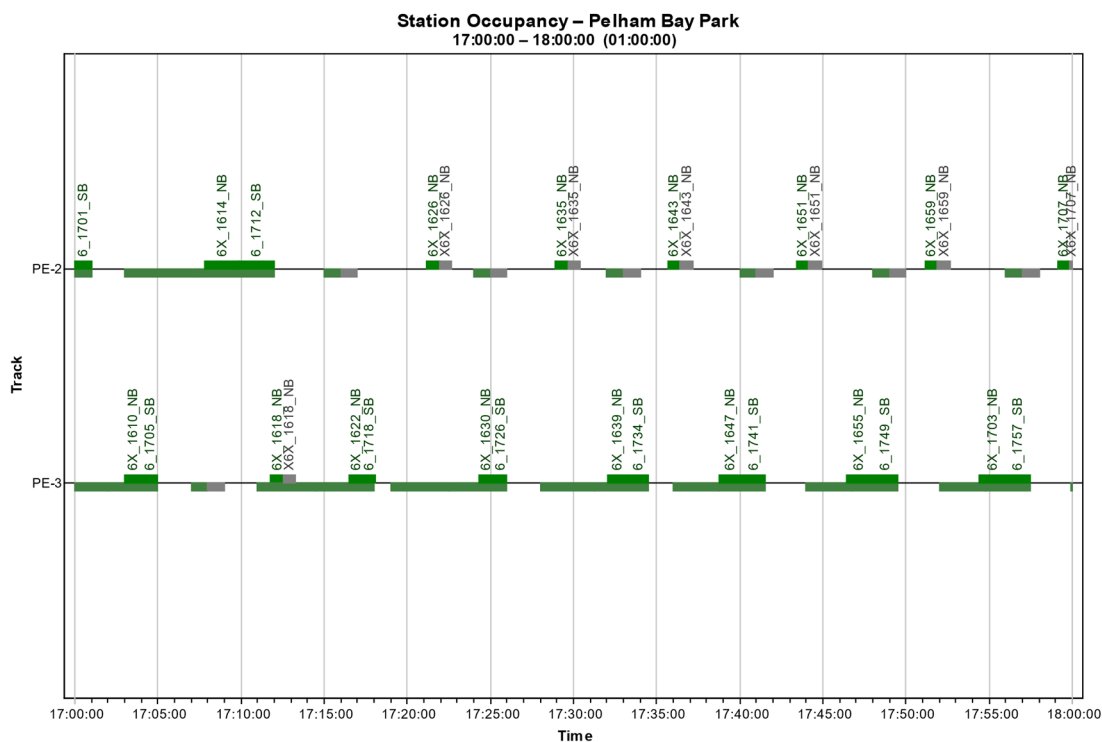
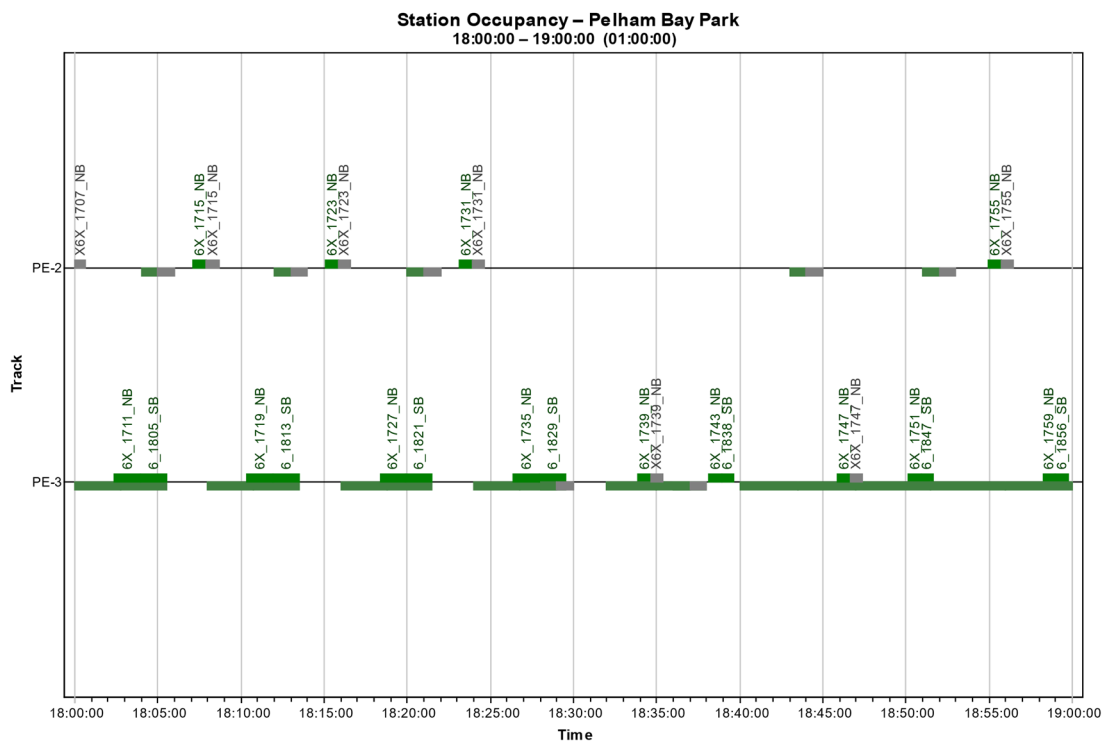


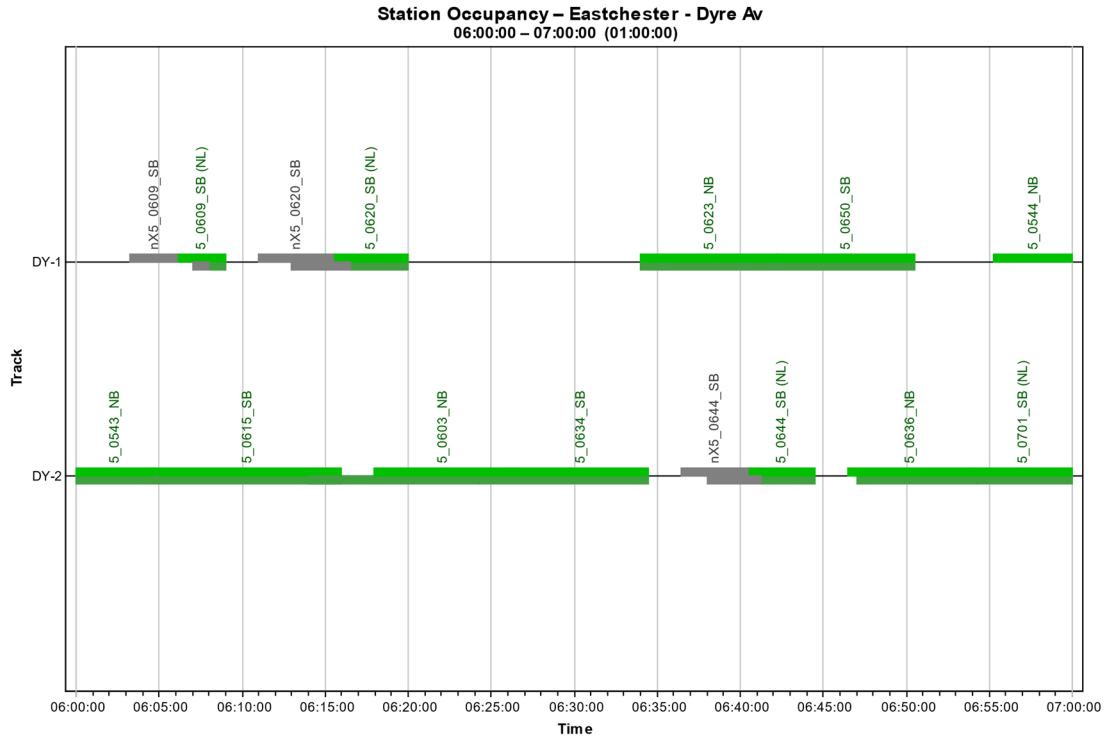
Figure G.5-40: Future Baseline (CBTC) Station Occupancy Chart – Pelham Bay Park – 6:00 to 7:00 p.m.



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G.5.6 Eastchester-Dyre Avenue

Figure G.5-41: Future Baseline (CBTC) Station Occupancy Chart – Eastchester-Dyre Avenue – 6:00 to 7:00 a.m.



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Figure G.5-42: Future Baseline (CBTC) Station Occupancy Chart – Eastchester-Dyre Avenue – 7:00 to 8:00 a.m.

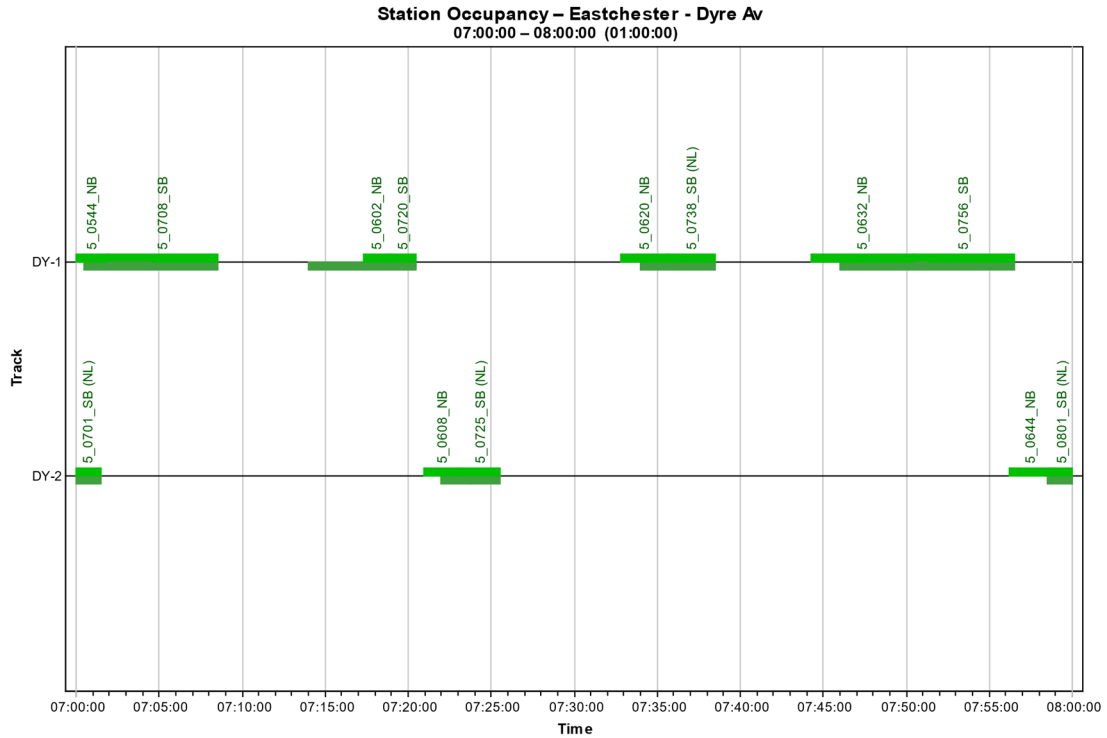
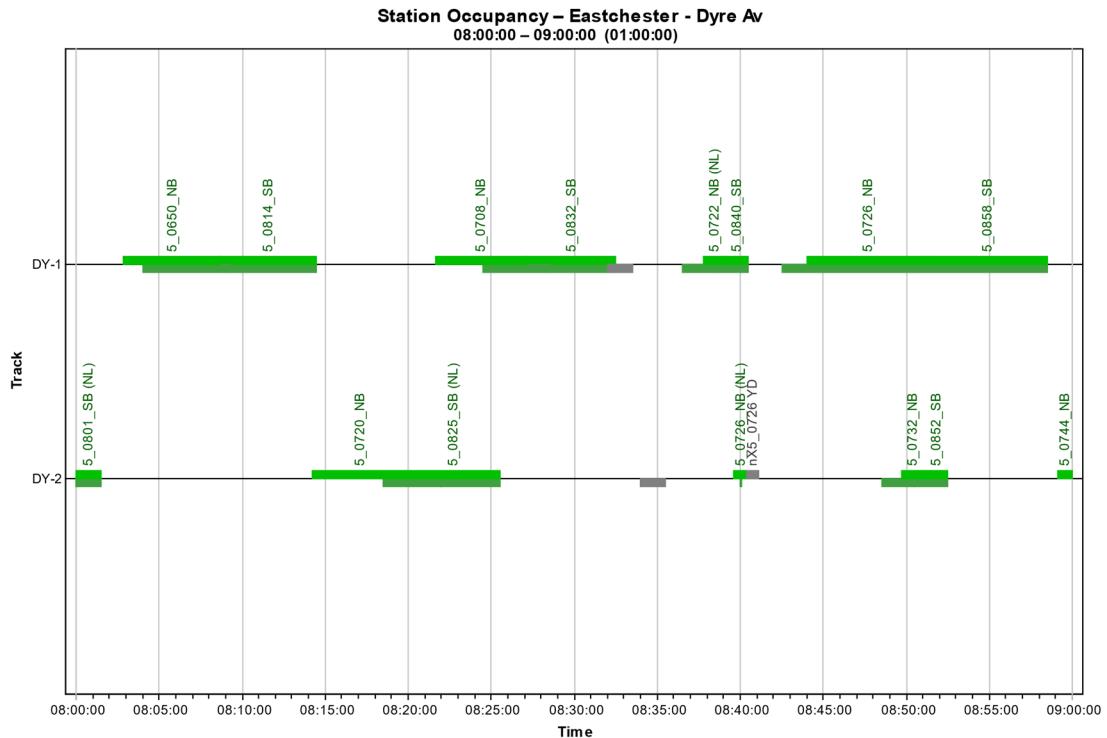


Figure G.5-43: Future Baseline (CBTC) Station Occupancy Chart – Eastchester-Dyre Avenue – 8:00 to 9:00 a.m.



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Figure G.5-44: Future Baseline (CBTC) Station Occupancy Chart – Eastchester-Dyre Avenue – 9:00 to 10:00 a.m.

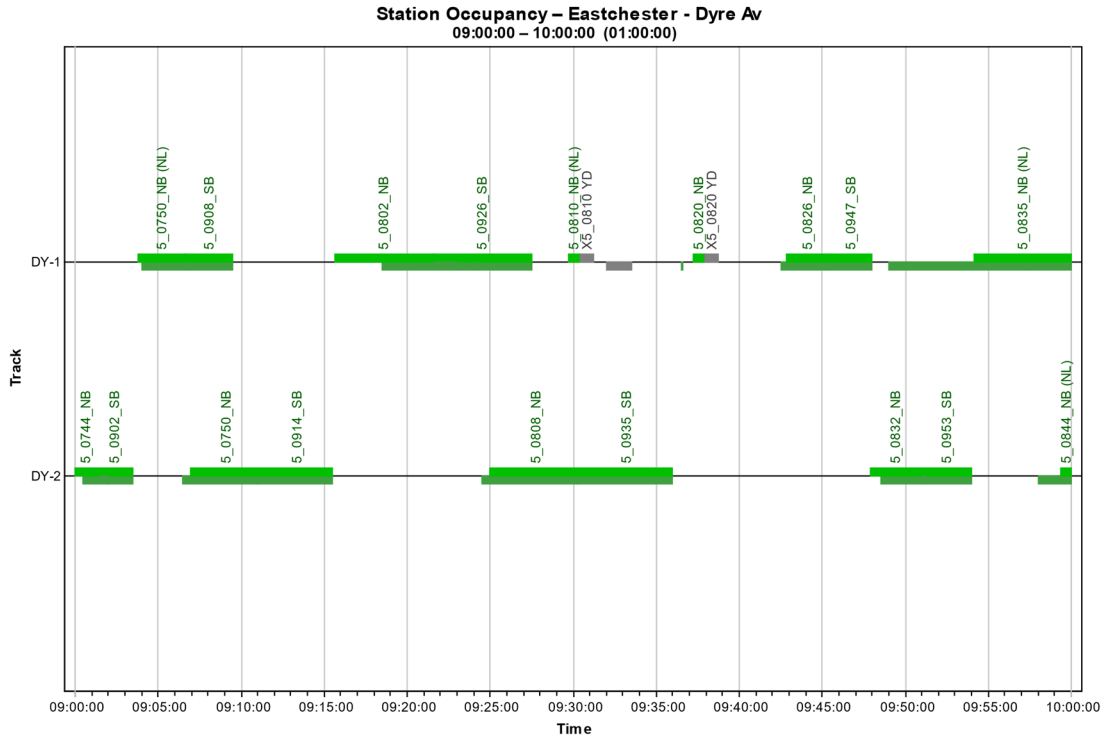
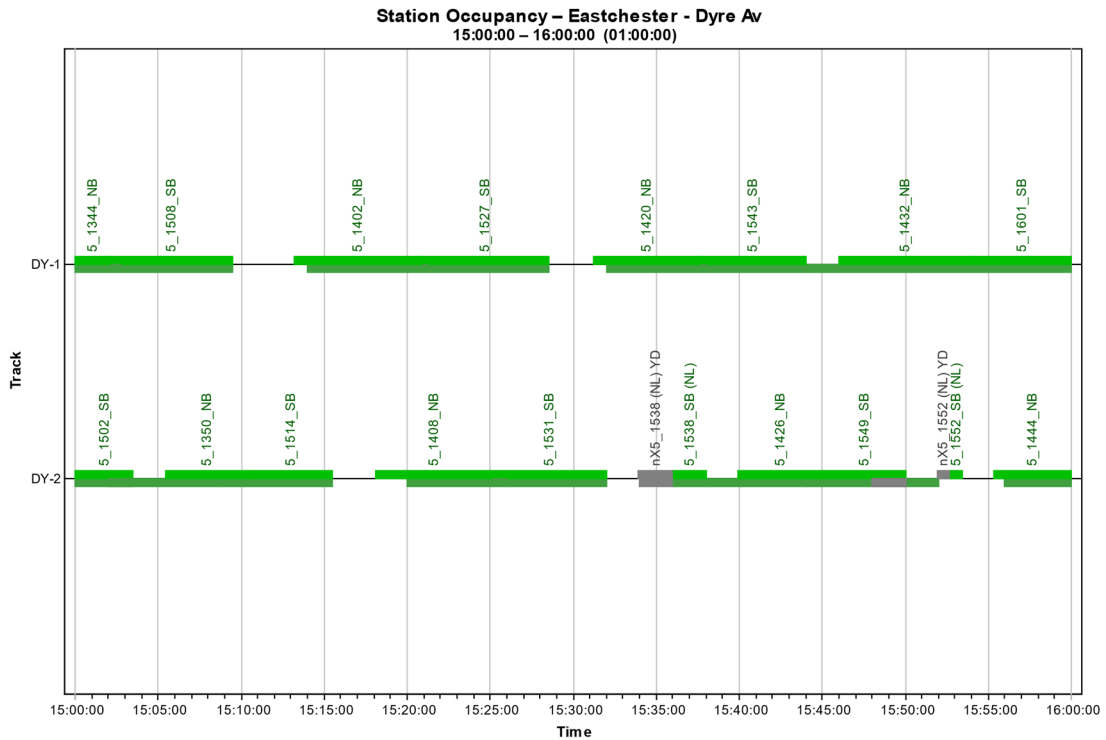


Figure G.5-45: Future Baseline (CBTC) Station Occupancy Chart – Eastchester-Dyre Avenue – 3:00 to 4:00 p.m.



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Figure G.5-46: Future Baseline (CBTC) Station Occupancy Chart – Eastchester-Dyre Avenue – 4:00 to 5:00 p.m.

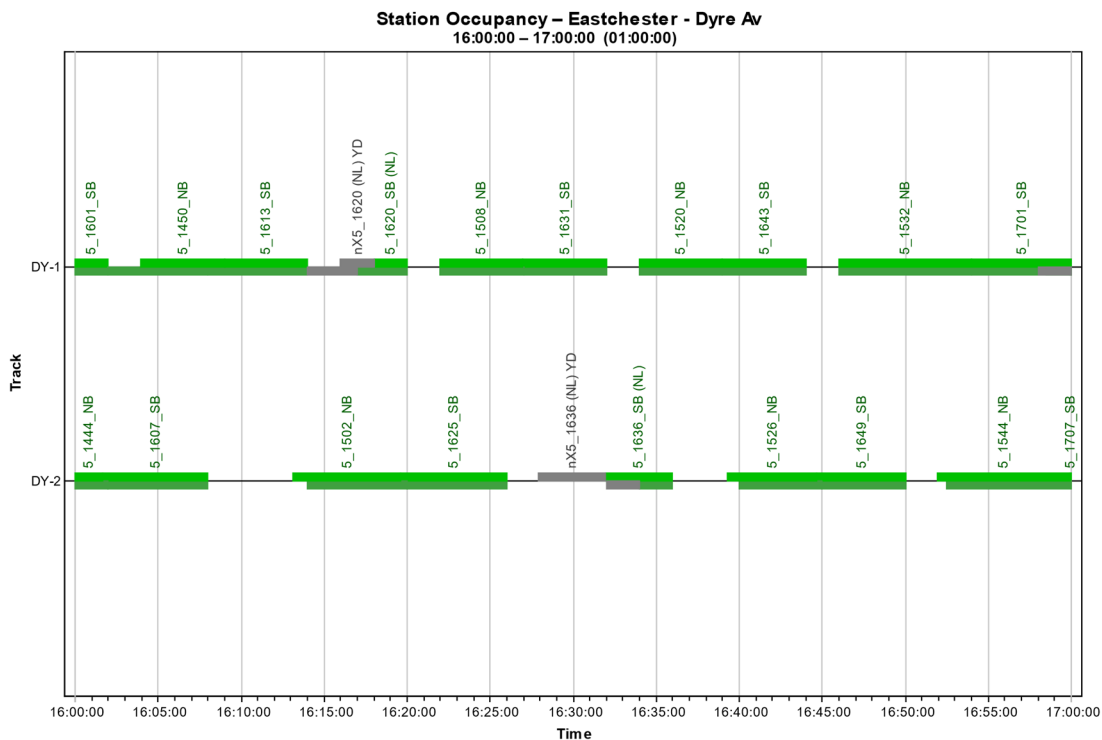
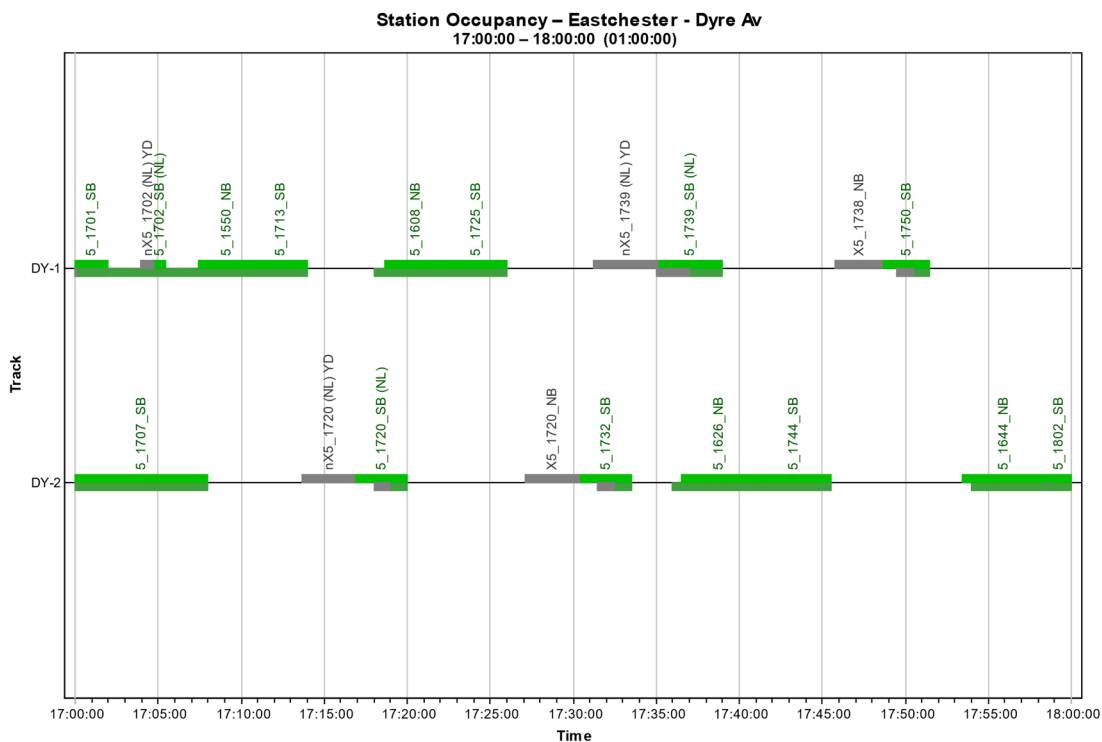
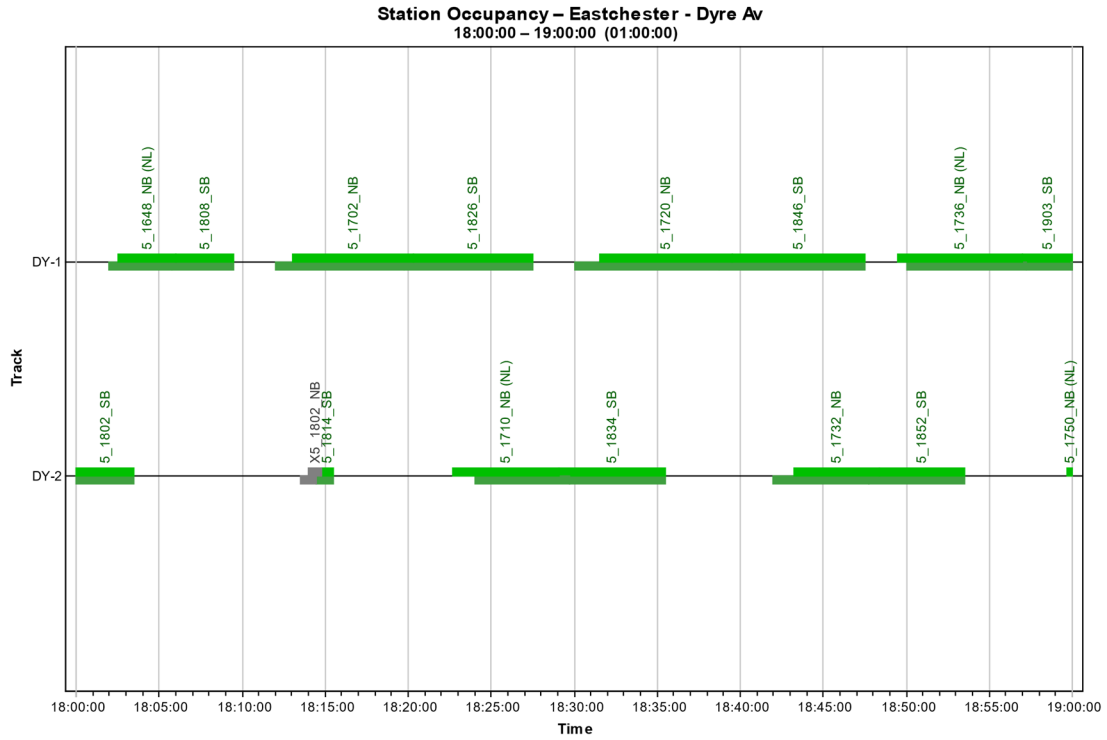


Figure G.5-47: Future Baseline (CBTC) Station Occupancy Chart – Eastchester-Dyre Avenue – 5:00 to 6:00 p.m.



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Figure G.5-48: Future Baseline (CBTC) Station Occupancy Chart – Eastchester-Dyre Avenue – 6:00 to 7:00 p.m.



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G.5.7 Wakefield-241 Street

Figure G.5-49: Future Baseline (CBTC) Station Occupancy Chart – Wakefield-241 Street – 6:00 to 7:00 a.m.

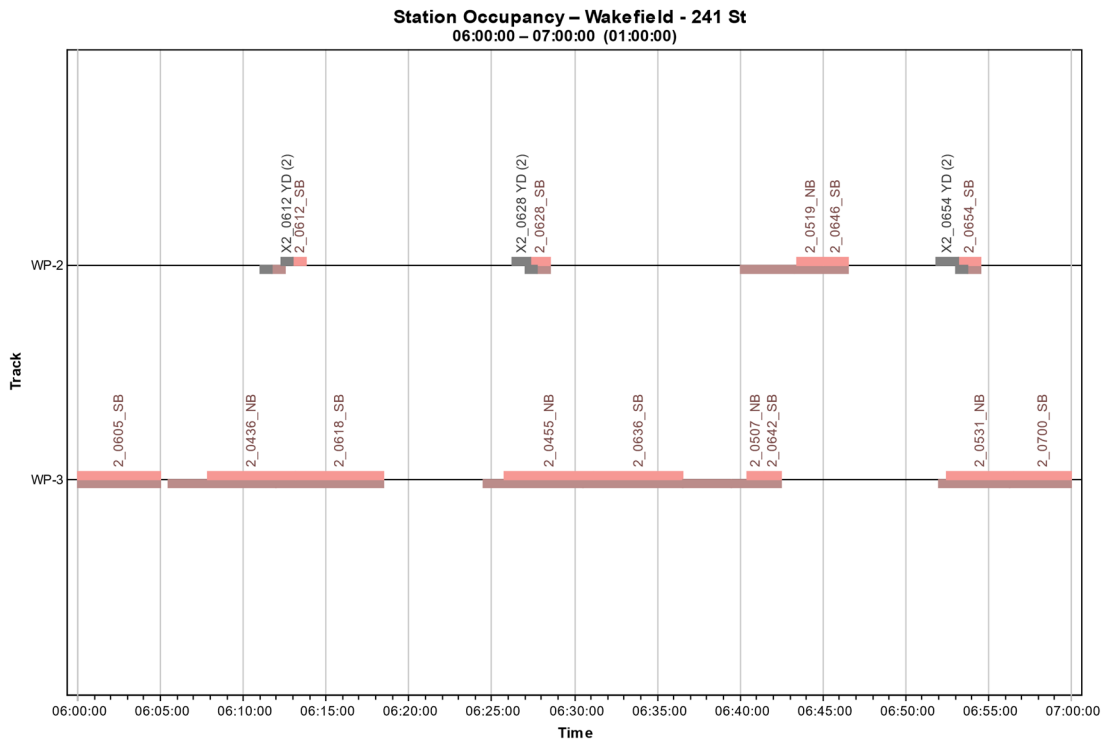
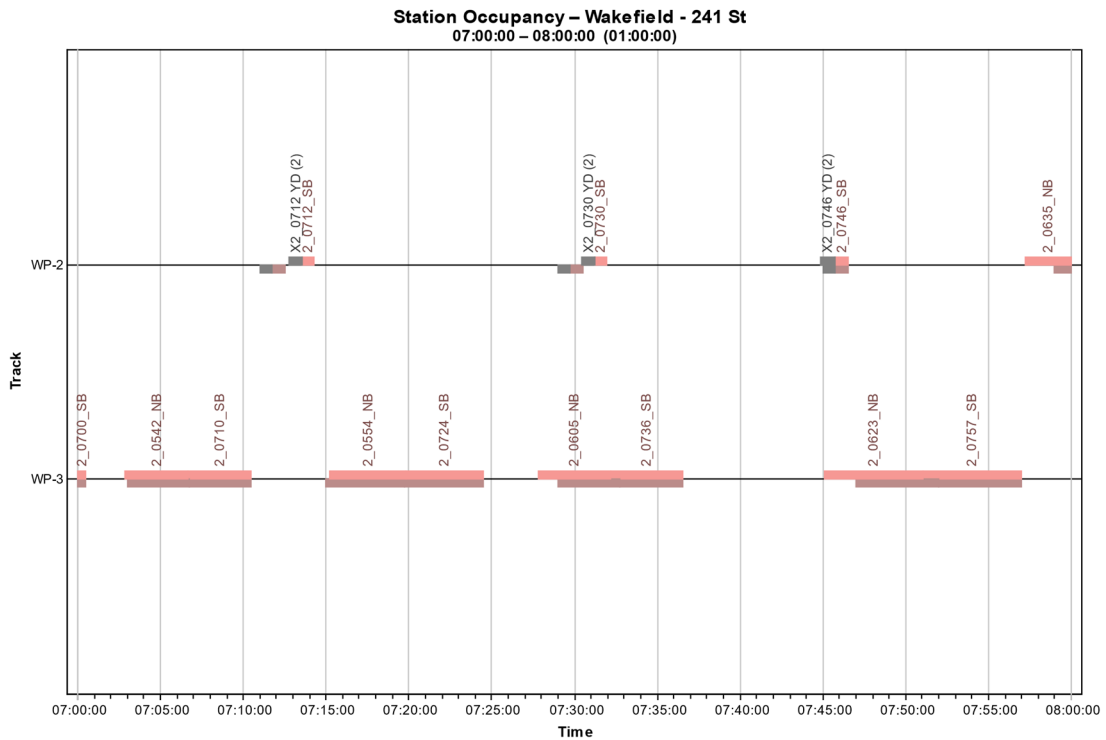


Figure G.5-50: Future Baseline (CBTC) Station Occupancy Chart – Wakefield-241 Street – 7:00 to 8:00 a.m.



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Figure G.5-51: Future Baseline (CBTC) Station Occupancy Chart – Wakefield-241 Street – 8:00 to 9:00 a.m.

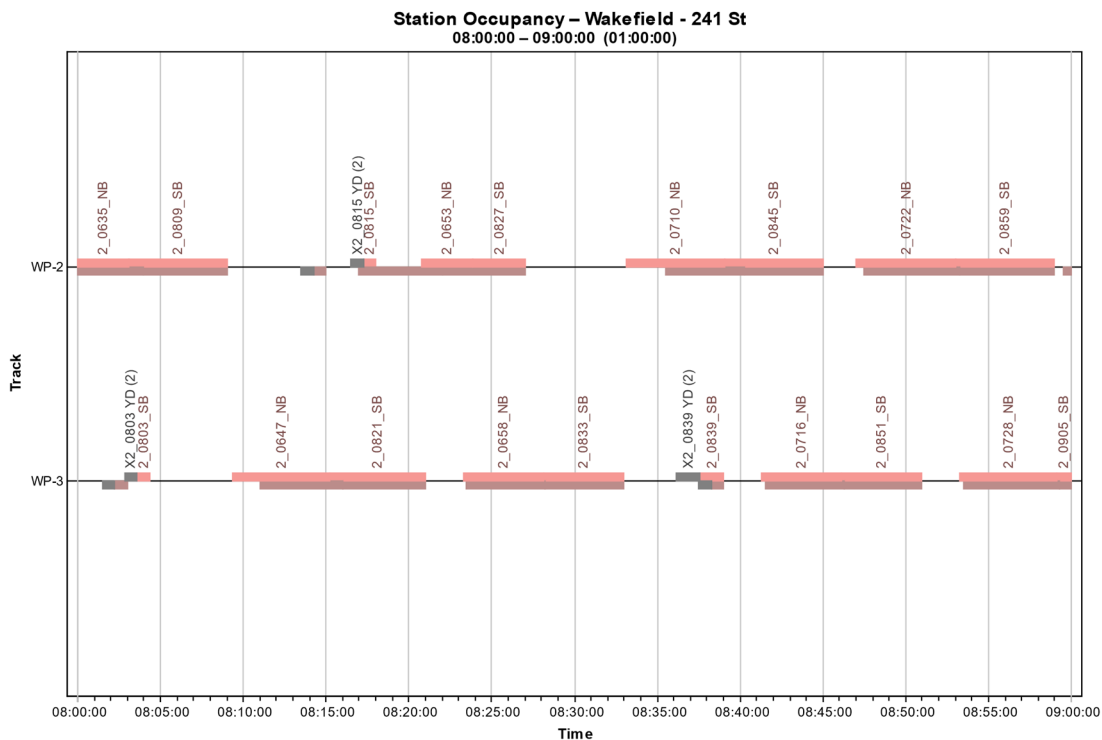
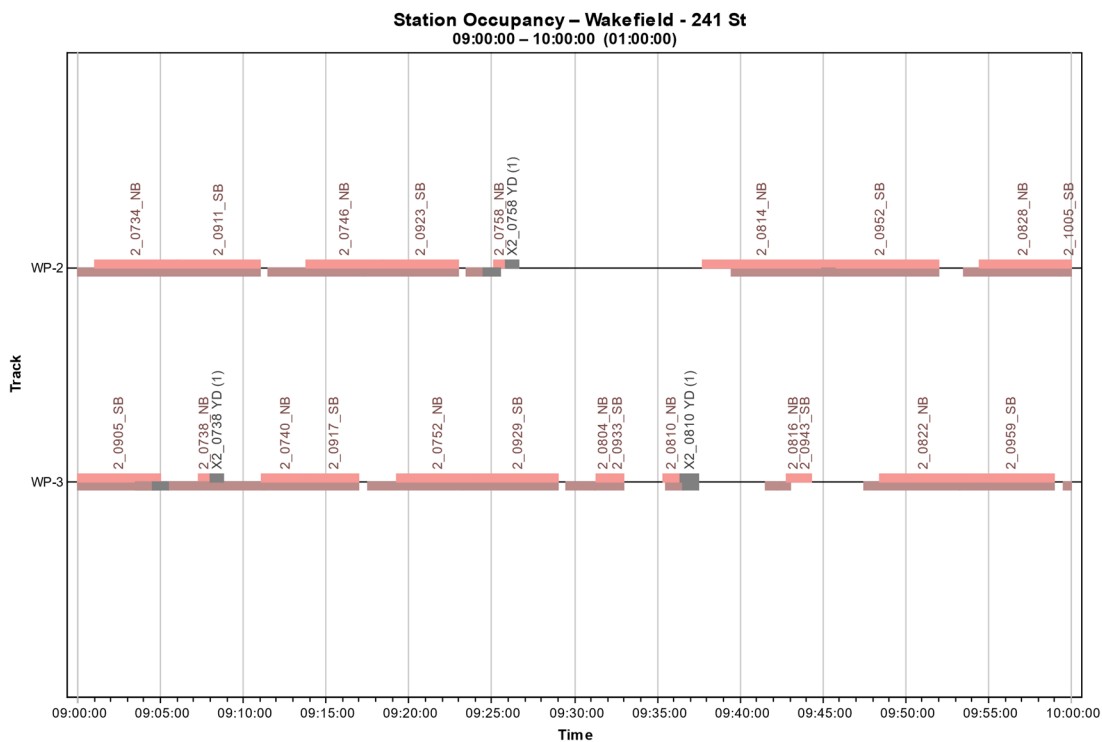


Figure G.5-52: Future Baseline (CBTC) Station Occupancy Chart – Wakefield-241 Street – 9:00 to 10:00 a.m.



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Figure G.5-53: Future Baseline (CBTC) Station Occupancy Chart – Wakefield-241 Street – 3:00 to 4:00 p.m.

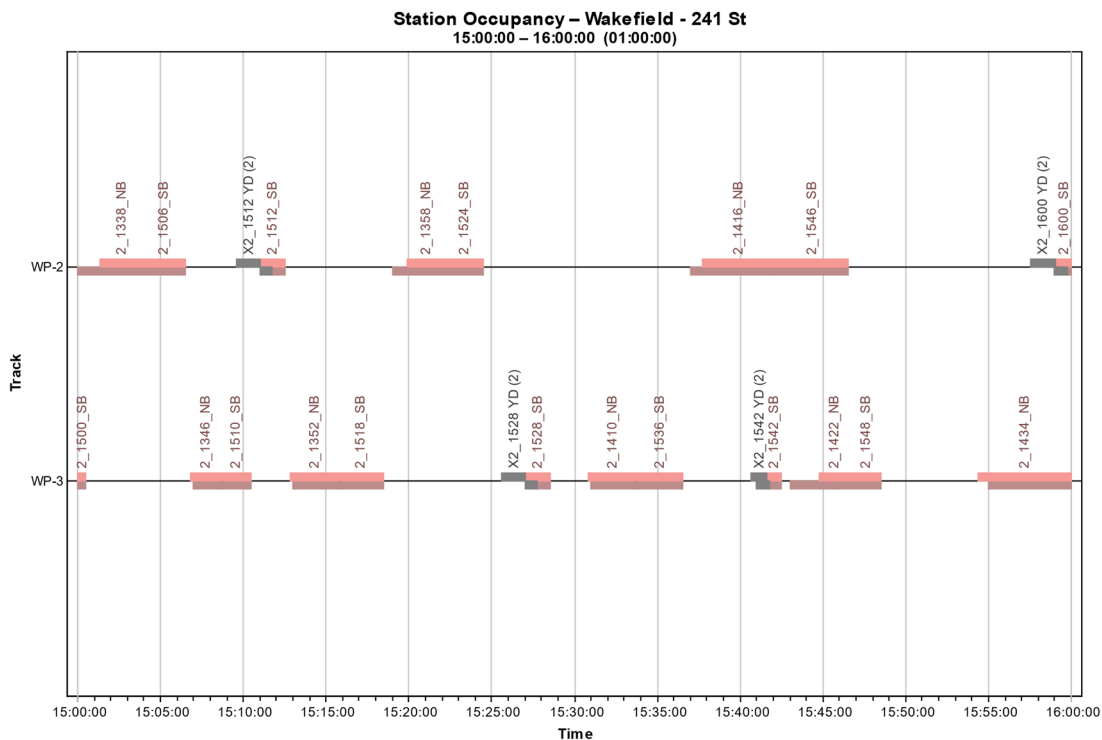
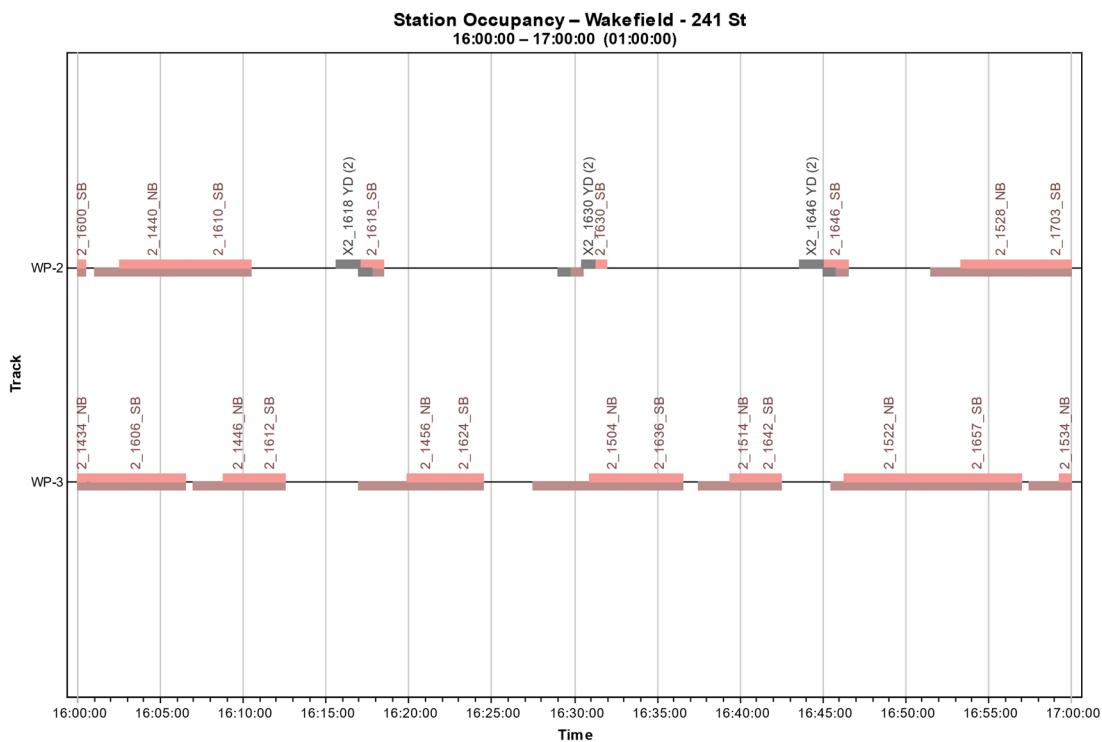


Figure G.5-54: Future Baseline (CBTC) Station Occupancy Chart – Wakefield-241 Street – 4:00 to 5:00 p.m.



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Figure G.5-55: Future Baseline (CBTC) Station Occupancy Chart – Wakefield-241 Street – 5:00 to 6:00 p.m.

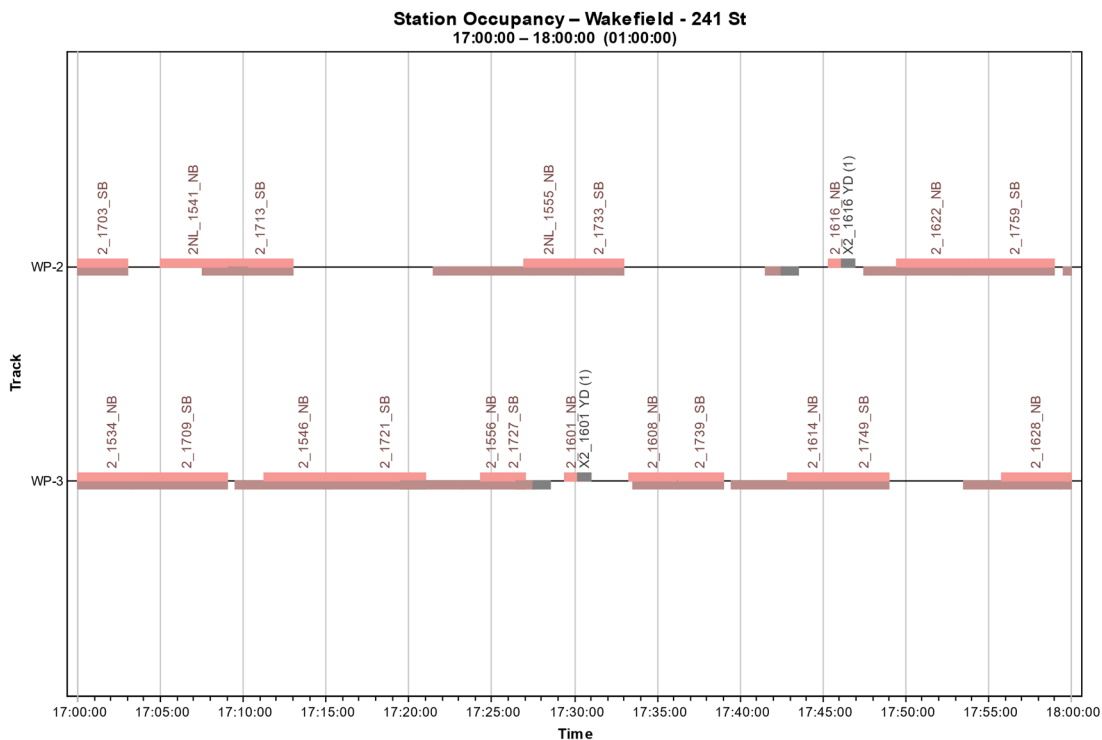
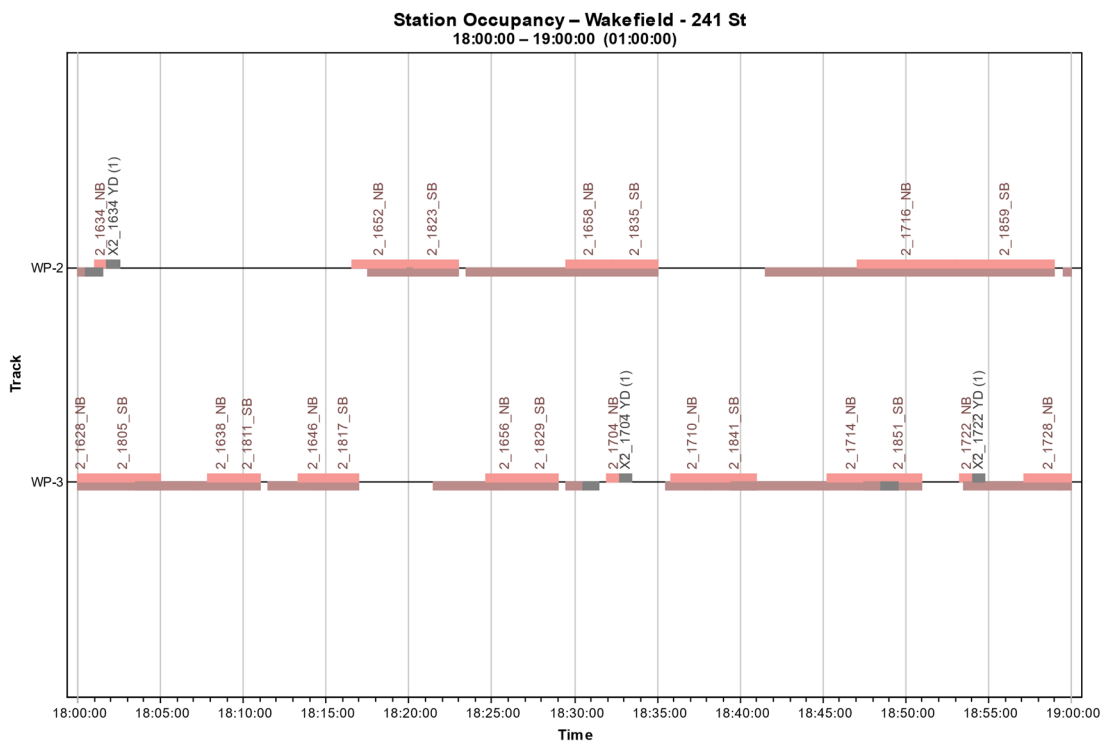


Figure G.5-56: Future Baseline (CBTC) Station Occupancy Chart – Wakefield-241 Street – 6:00 to 7:00 p.m.



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G.5.8 Woodlawn

Figure G.5-57: Future Baseline (CBTC) Station Occupancy Chart – Woodlawn – 6:00 to 7:00 a.m.

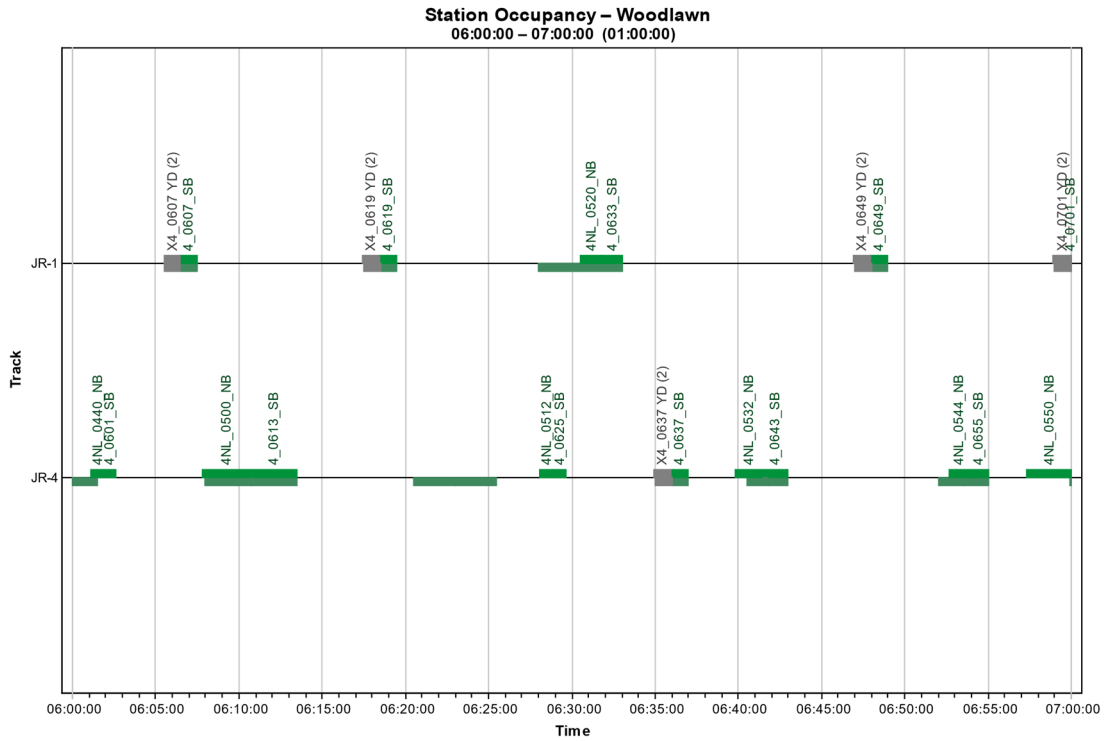
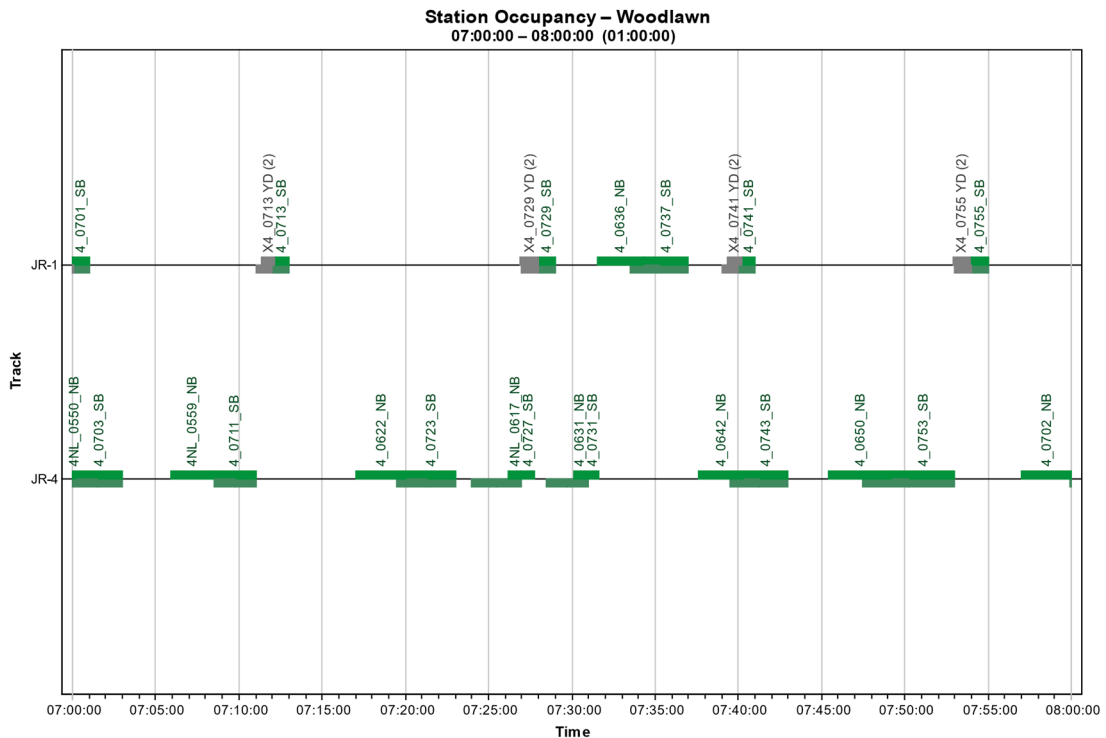


Figure G.5-58: Future Baseline (CBTC) Station Occupancy Chart – Woodlawn – 7:00 to 8:00 a.m.



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Figure G.5-59: Future Baseline (CBTC) Station Occupancy Chart – Woodlawn – 8:00 to 9:00 a.m.

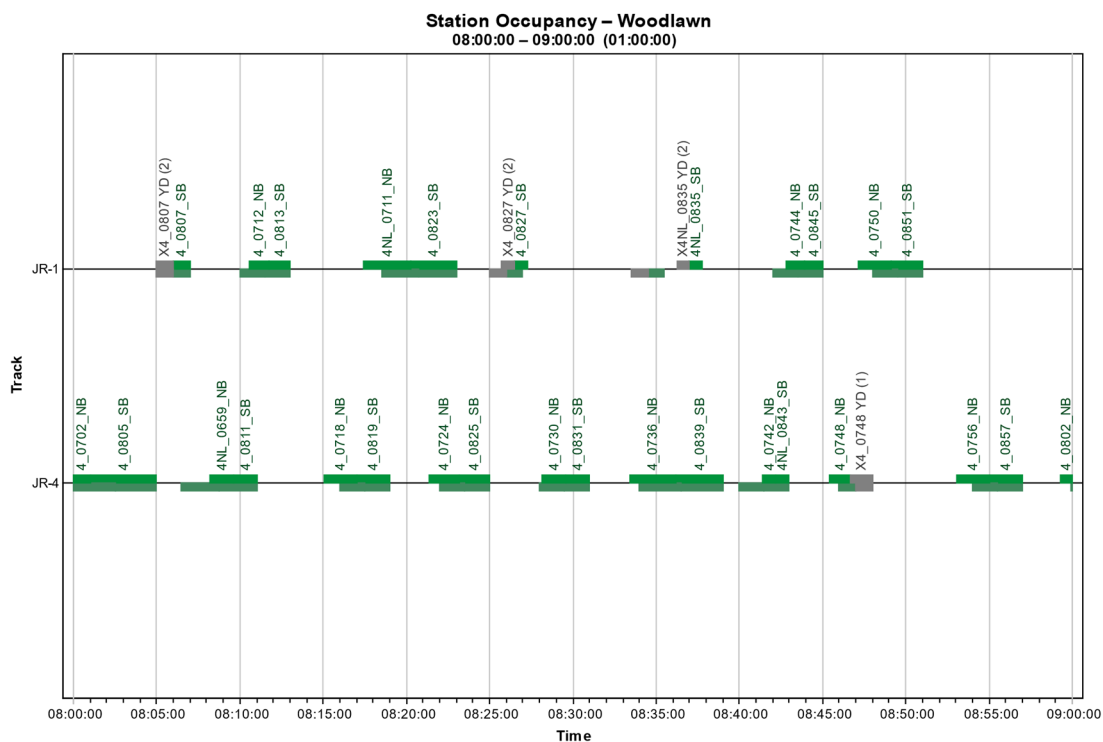
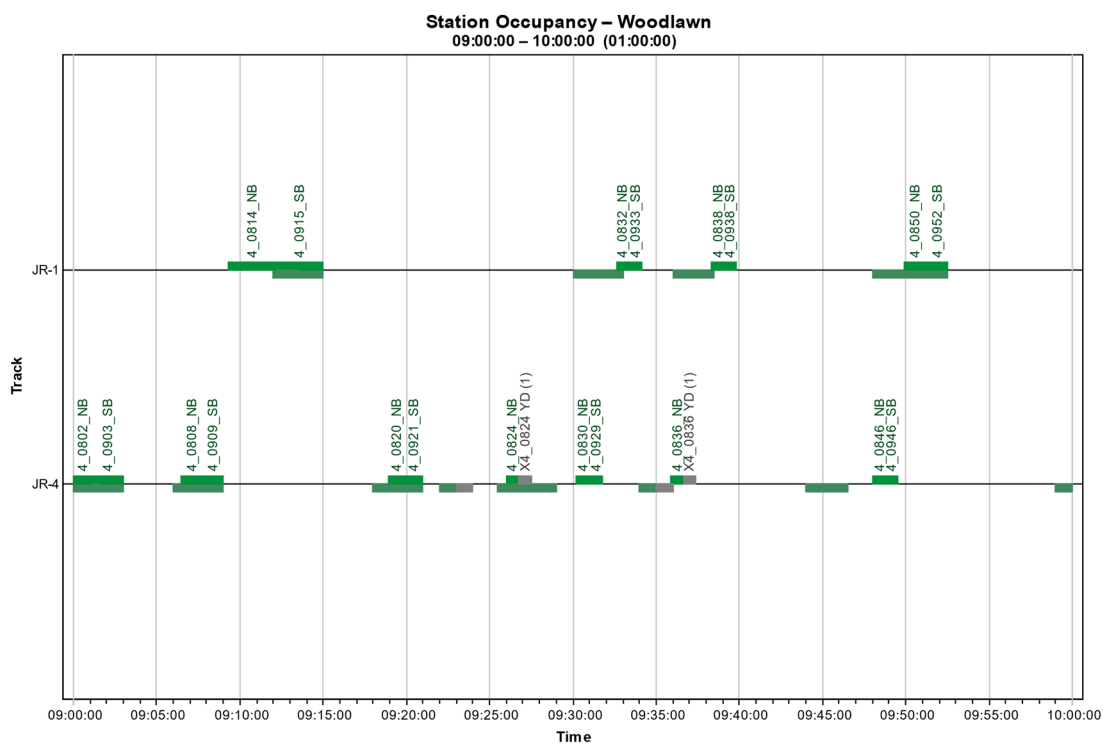


Figure G.5-60: Future Baseline (CBTC) Station Occupancy Chart – Woodlawn – 9:00 to 10:00 a.m.



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Figure G.5-61: Future Baseline (CBTC) Station Occupancy Chart – Woodlawn – 3:00 to 4:00 p.m.

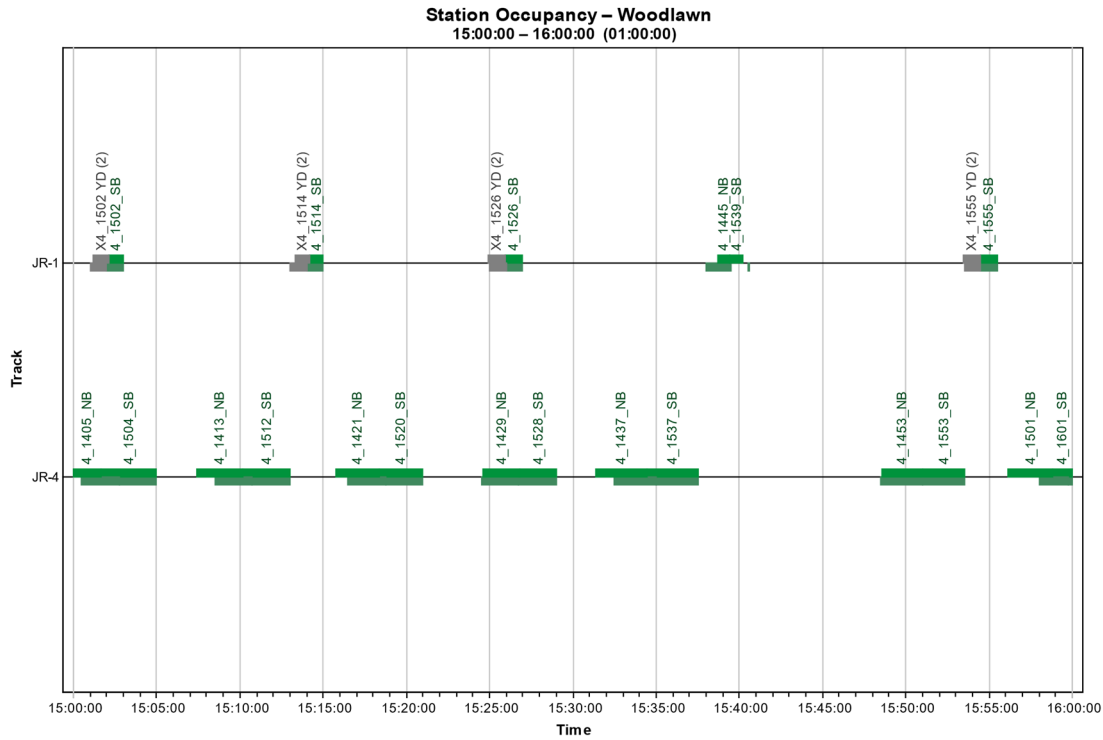
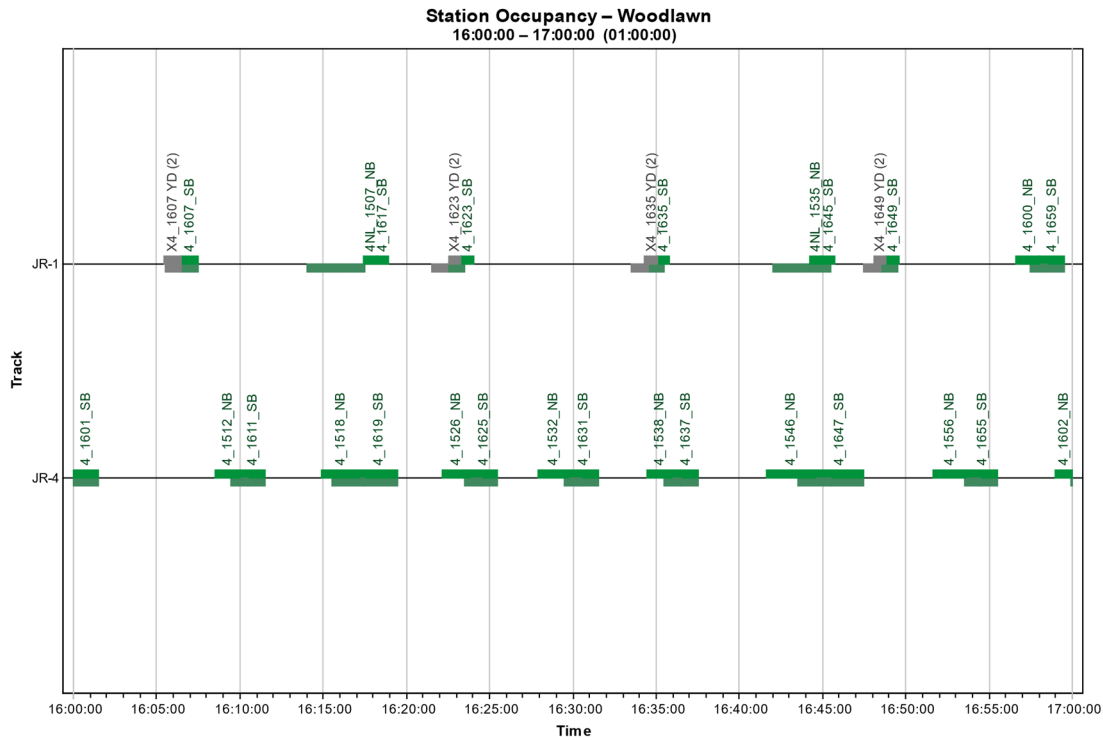


Figure G.5-62: Future Baseline (CBTC) Station Occupancy Chart – Woodlawn – 4:00 to 5:00 p.m.



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Figure G.5-63: Future Baseline (CBTC) Station Occupancy Chart – Woodlawn – 5:00 to 6:00 p.m.

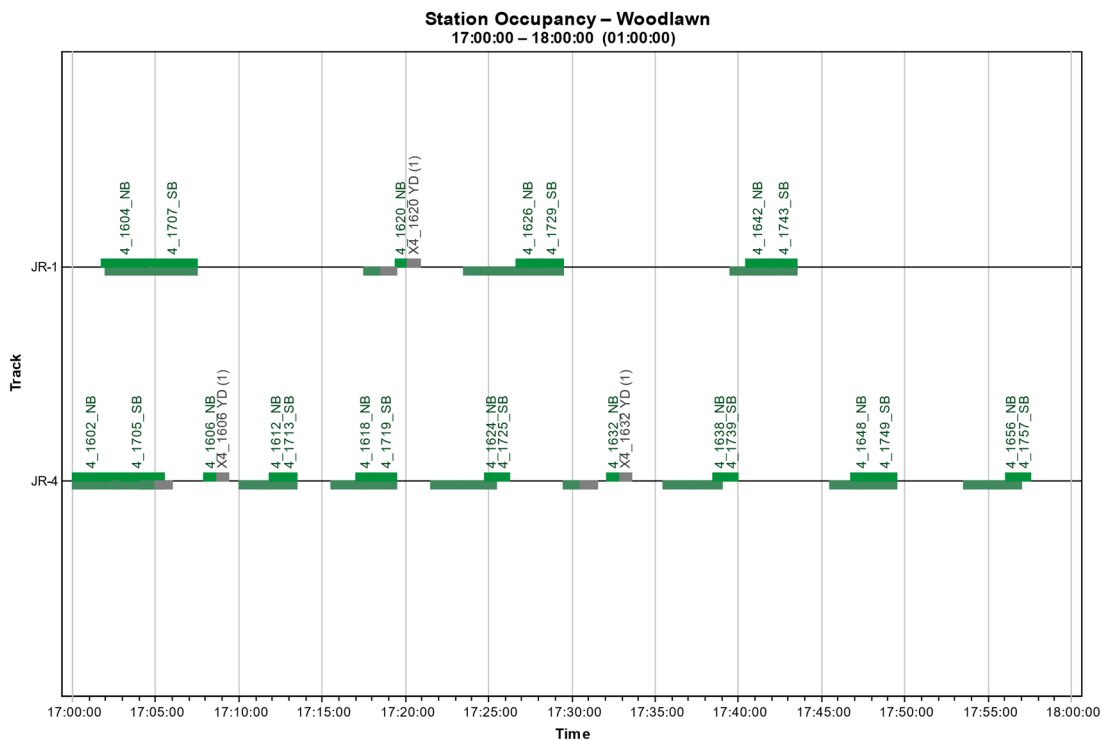
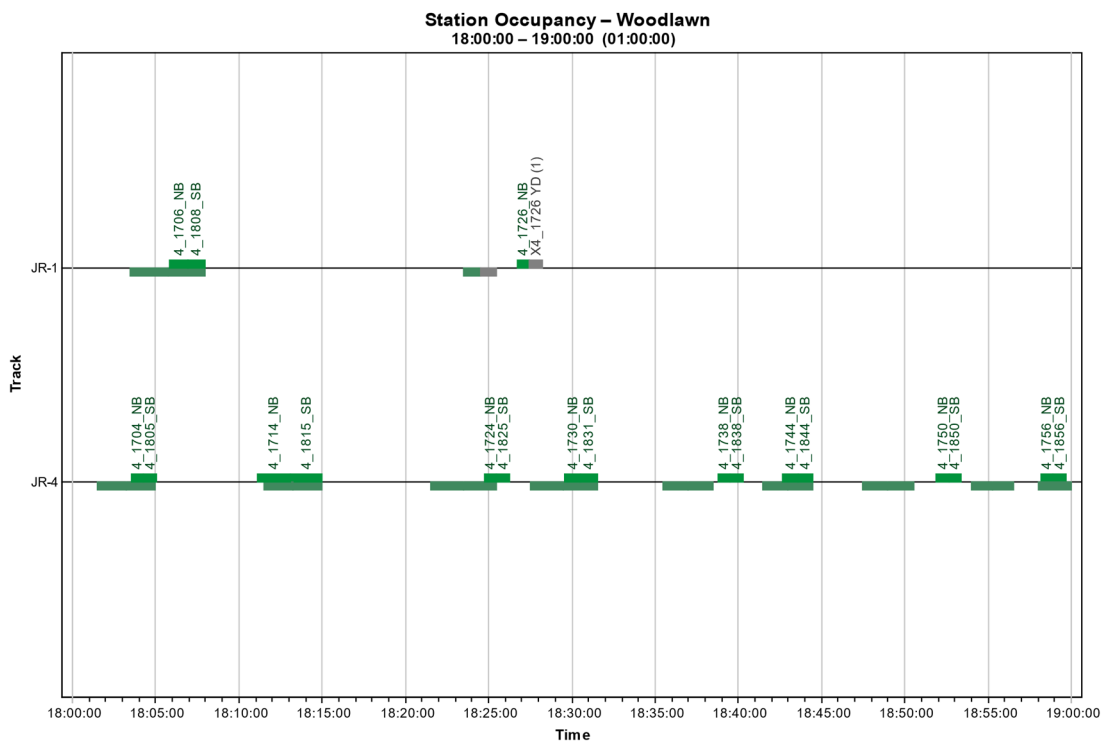


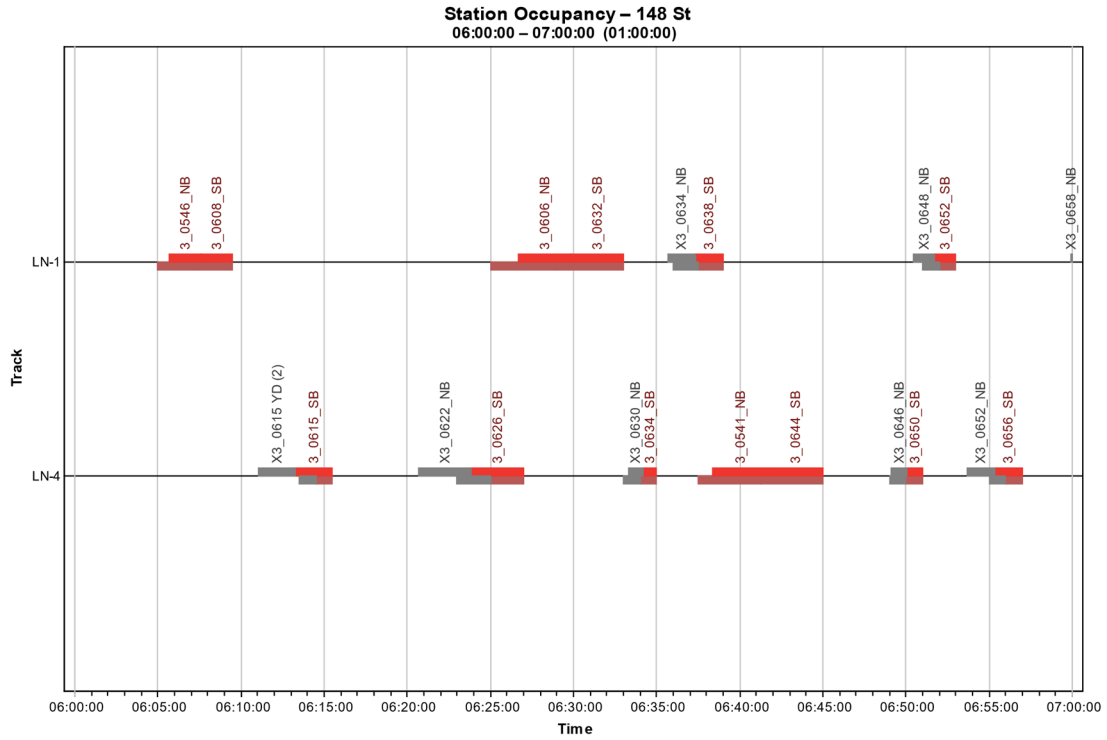
Figure G.5-64: Future Baseline (CBTC) Station Occupancy Chart – Woodlawn – 6:00 to 7:00 p.m.



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G.5.9 Harlem-148 Street

Figure G.5-65: Future Baseline (CBTC) Station Occupancy Chart –
Harlem-148 Street – 6:00 to 7:00 a.m.



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Figure G.5-66: Future Baseline (CBTC) Station Occupancy Chart –
Harlem-148 Street – 7:00 to 8:00 a.m.

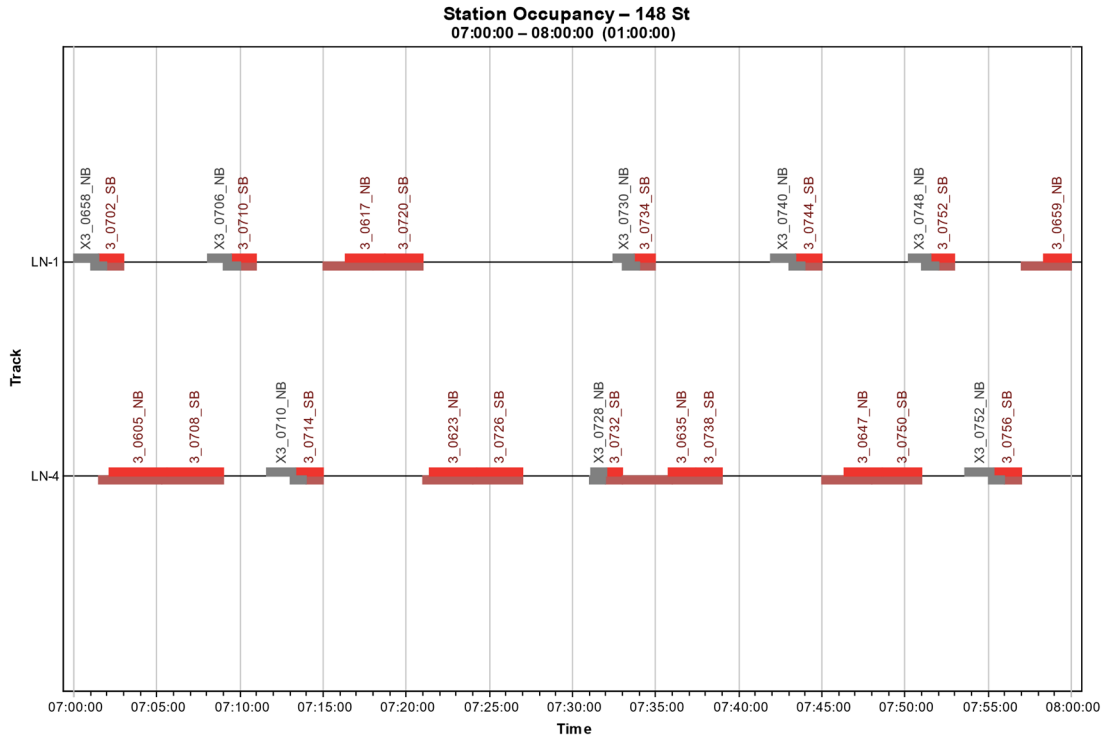
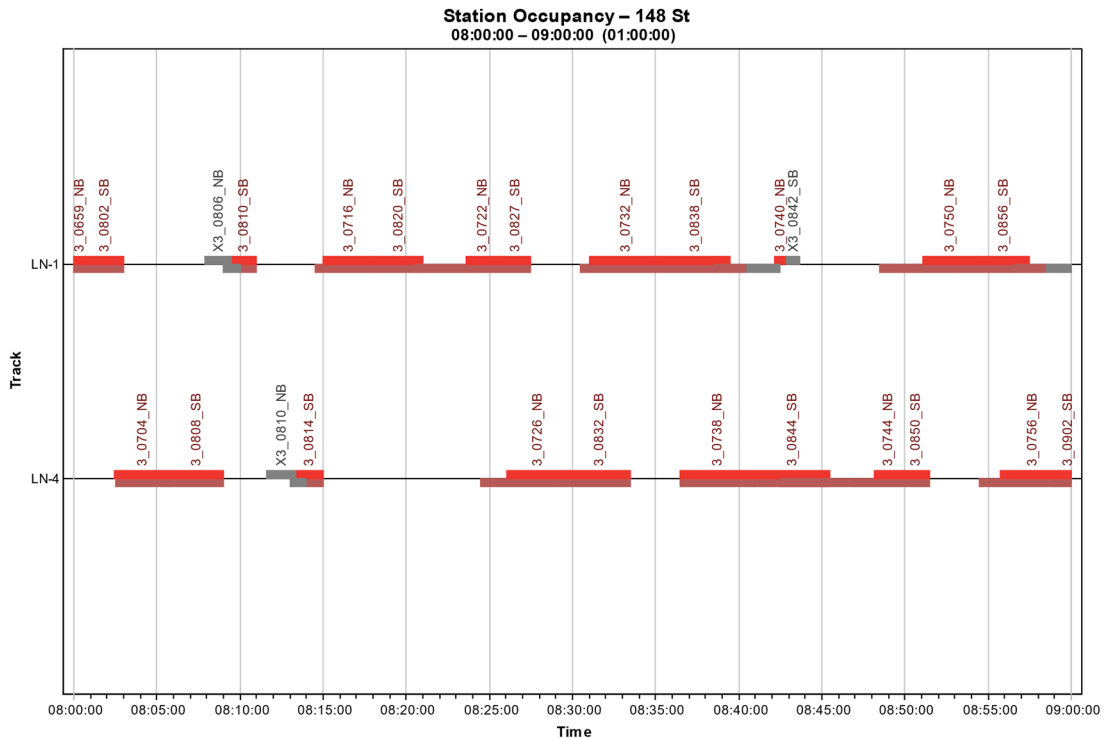


Figure G.5-67: Future Baseline (CBTC) Station Occupancy Chart –
Harlem-148 Street – 8:00 to 9:00 a.m.



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Figure G.5-68: Future Baseline (CBTC) Station Occupancy Chart –
Harlem-148 Street – 9:00 to 10:00 a.m.

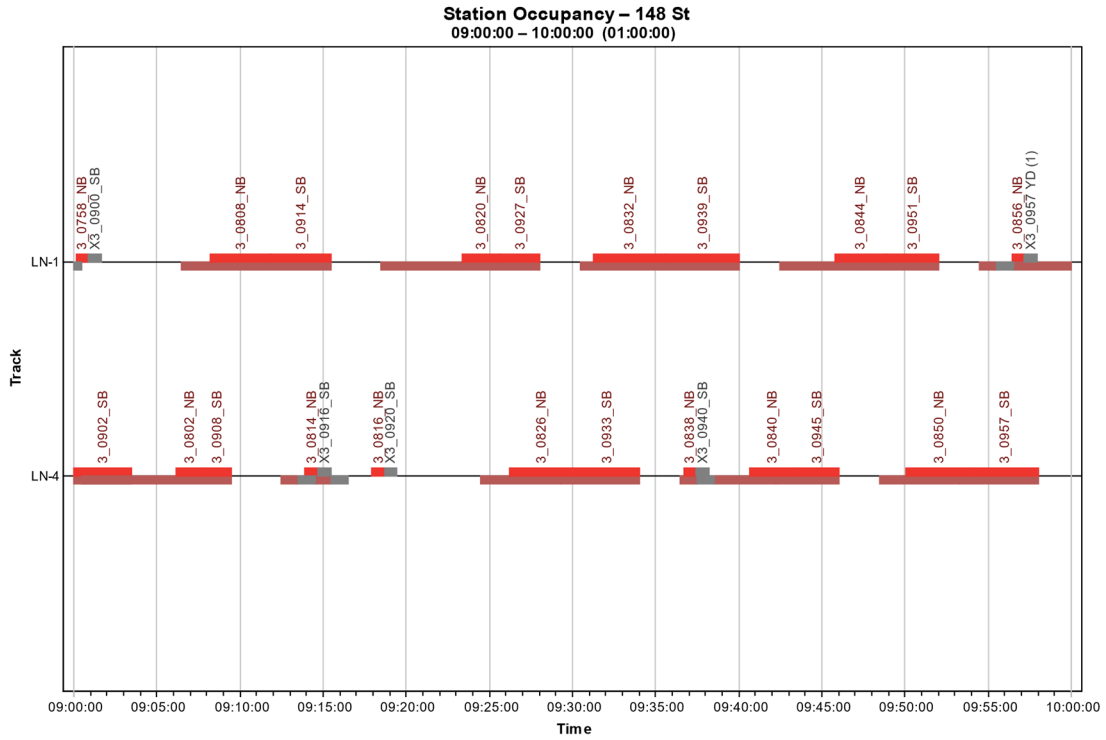
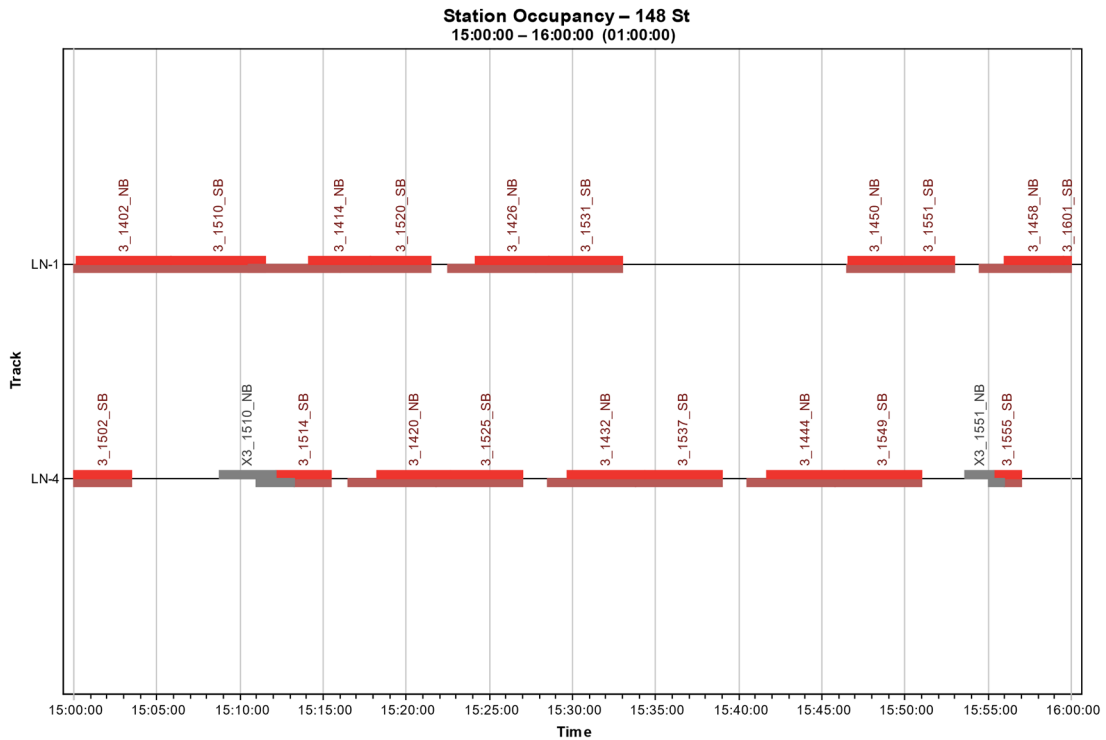


Figure G.5-69: Future Baseline (CBTC) Station Occupancy Chart –
Harlem-148 Street – 3:00 to 4:00 p.m.



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Figure G.5-70: Future Baseline (CBTC) Station Occupancy Chart –
Harlem-148 Street – 4:00 to 5:00 p.m.

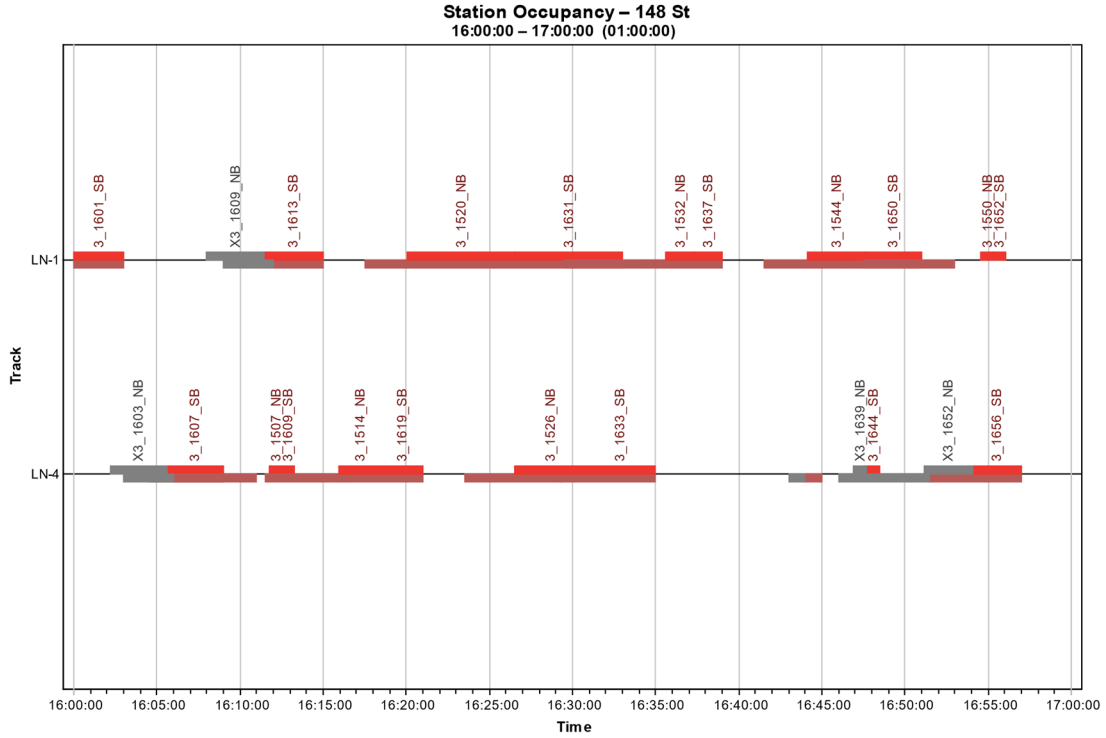
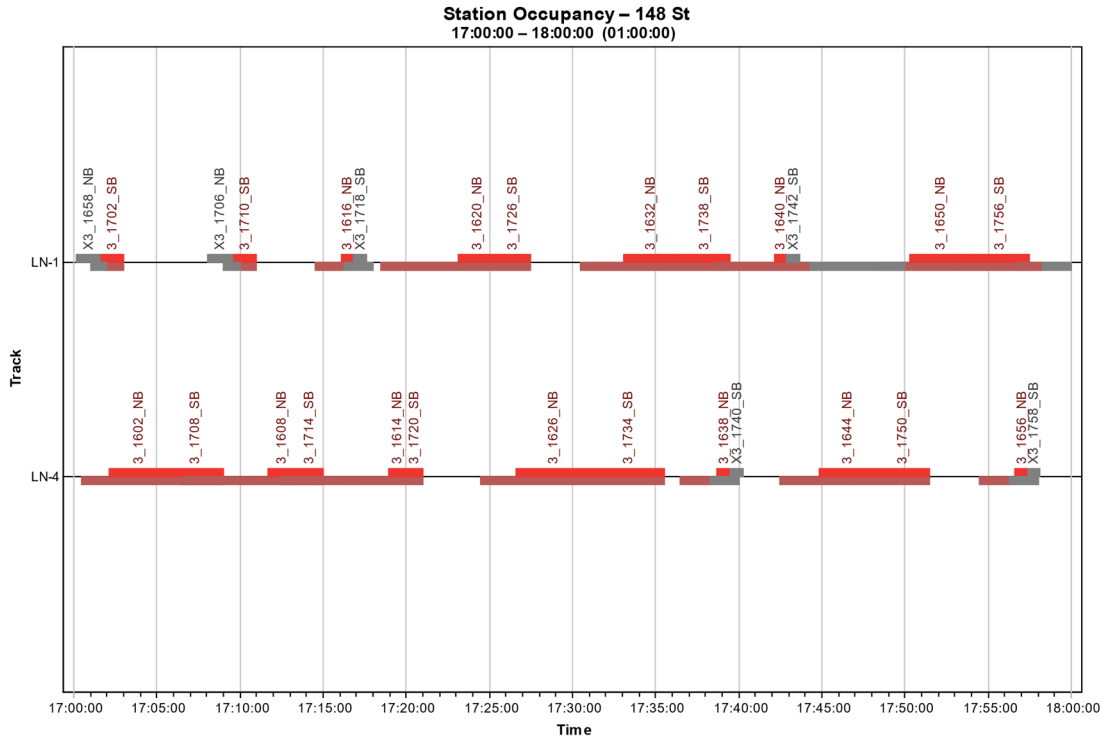
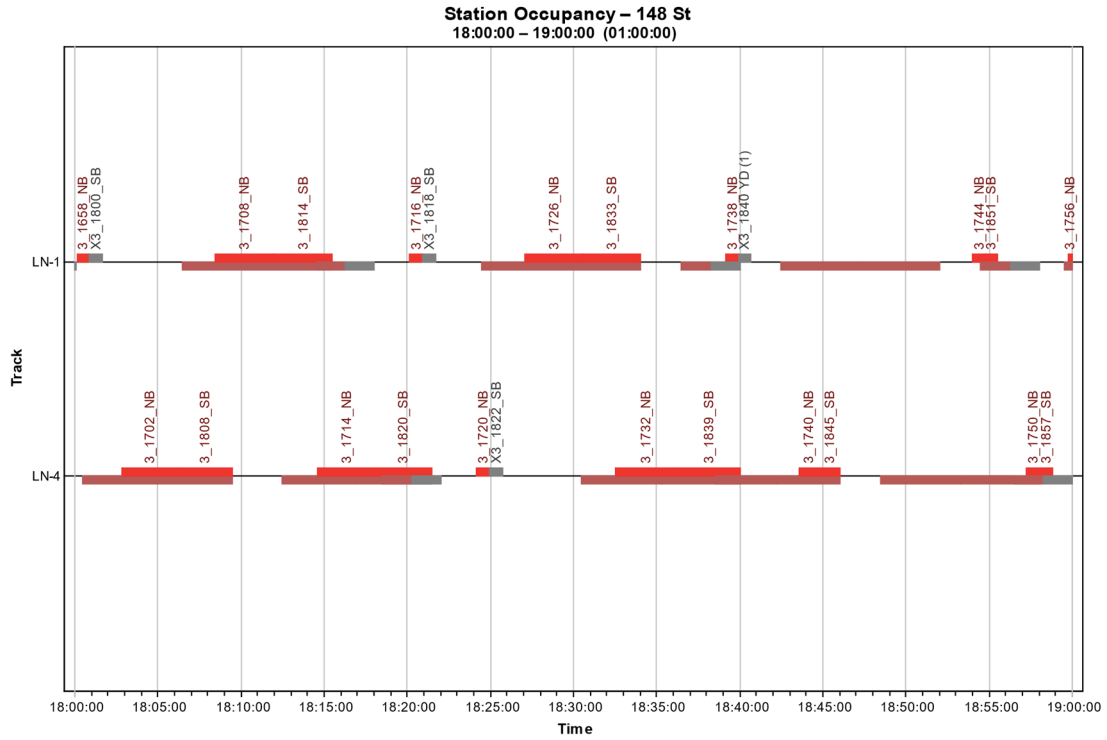


Figure G.5-71: Future Baseline (CBTC) Station Occupancy Chart –
Harlem-148 Street – 5:00 to 6:00 p.m.



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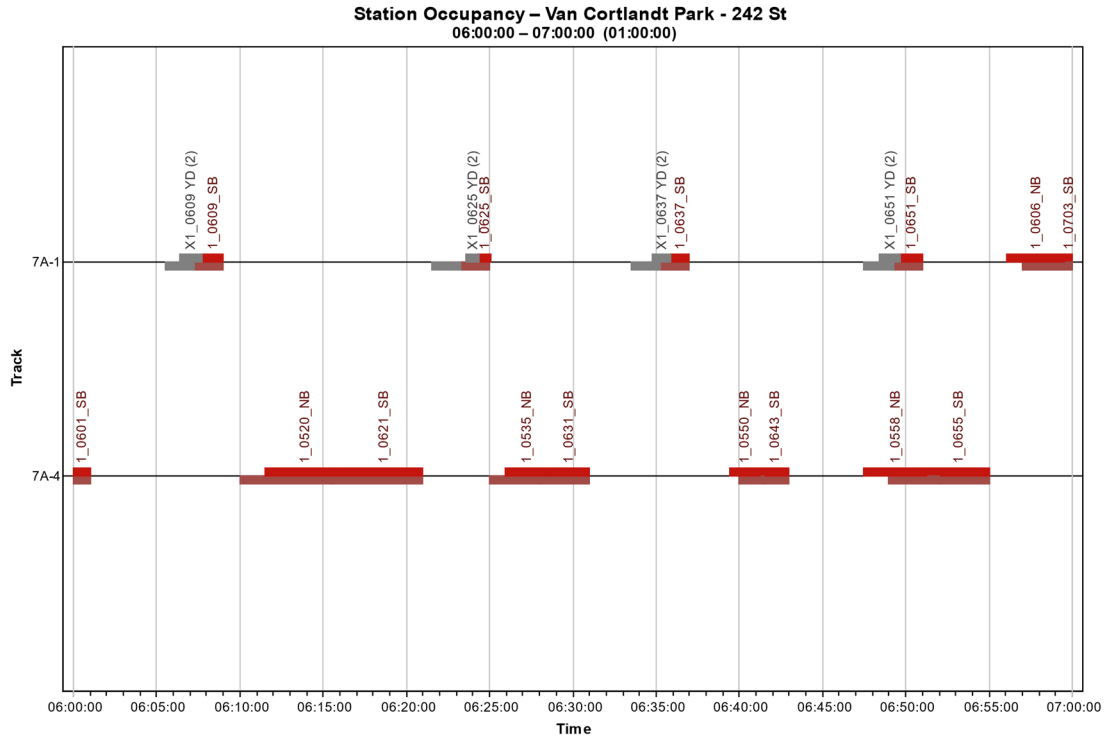
Figure G.5-72: Future Baseline (CBTC) Station Occupancy Chart –
Harlem-148 Street – 6:00 to 7:00 p.m.



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G.5.10 Van Cortlandt Park-242 Street

Figure G.5-73: Future Baseline (CBTC) Station Occupancy Chart –
Van Cortlandt Park-242 Street – 6:00 to 7:00 a.m.



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Figure G.5-74: Future Baseline (CBTC) Station Occupancy Chart –
Van Cortlandt Park-242 Street – 7:00 to 8:00 a.m.

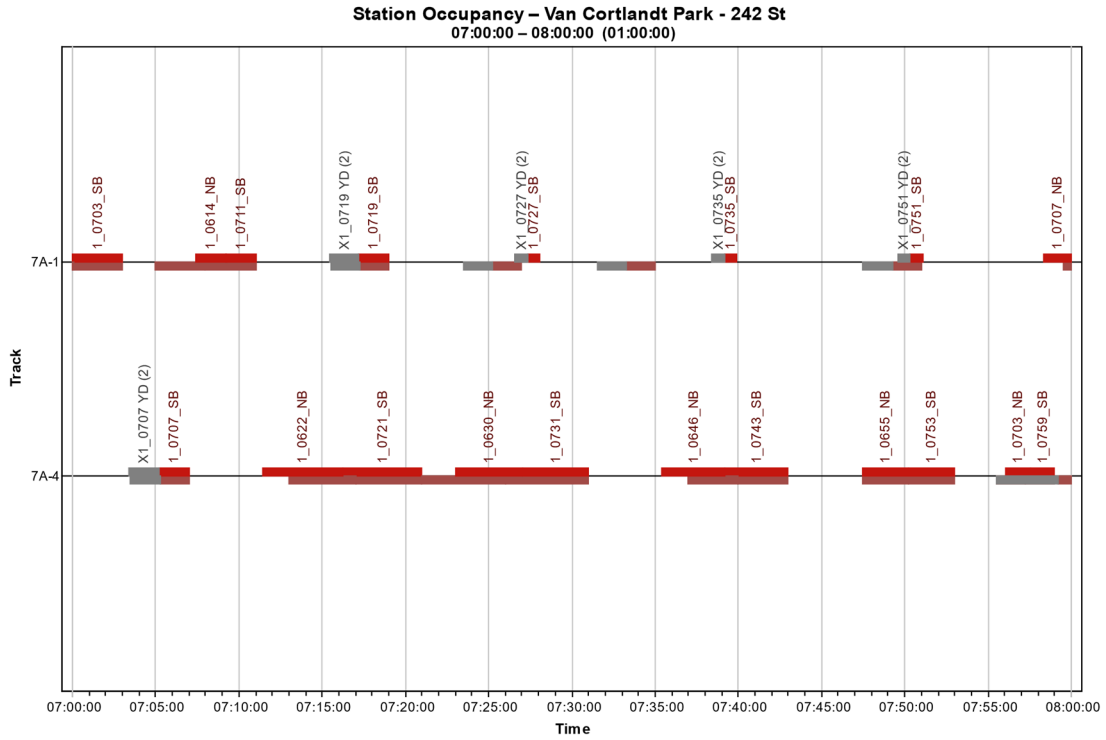
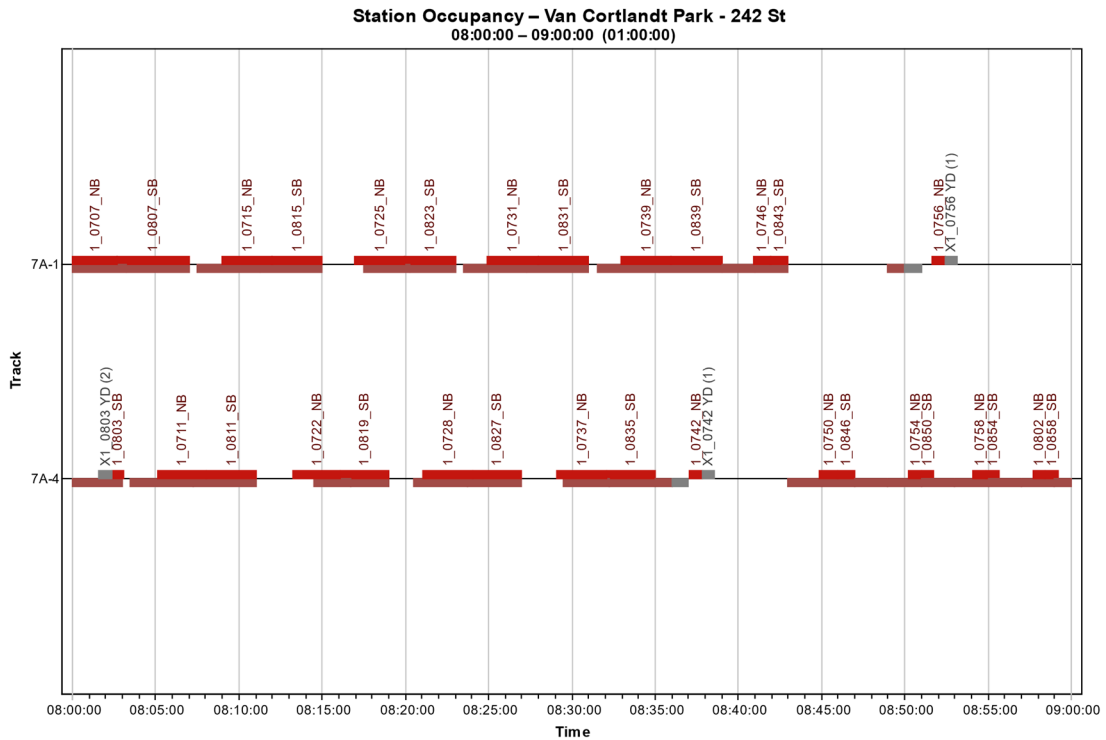
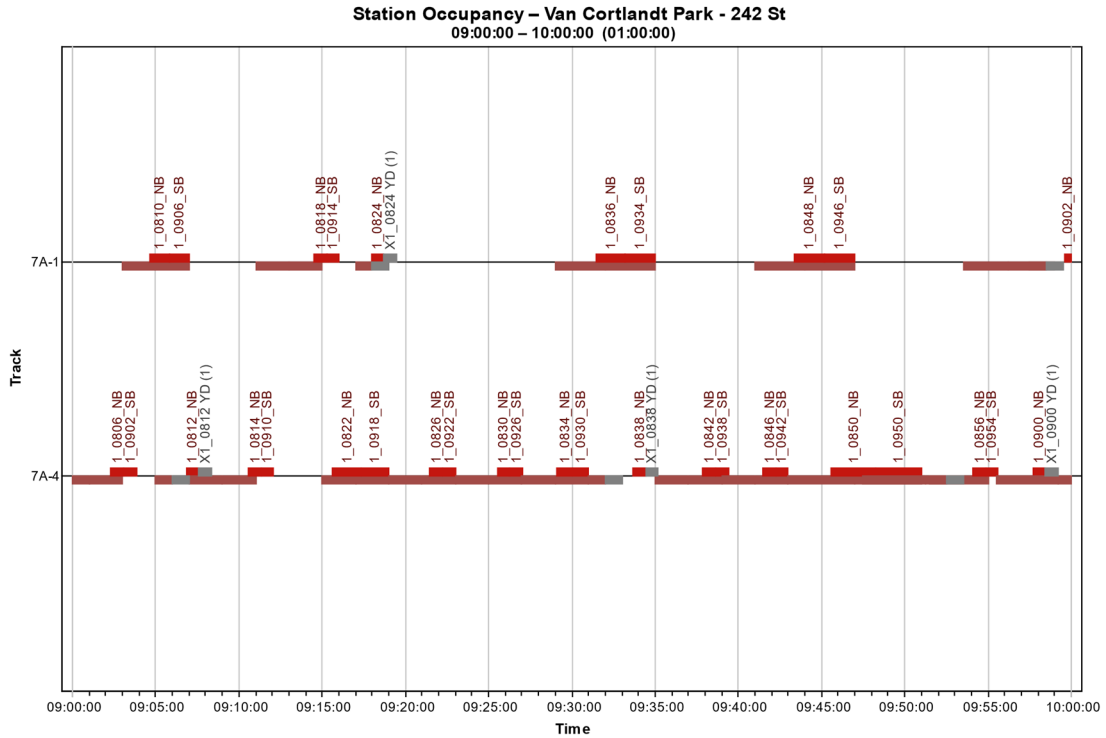


Figure G.5-75: Future Baseline (CBTC) Station Occupancy Chart –
Van Cortlandt Park-242 Street – 8:00 to 9:00 a.m.

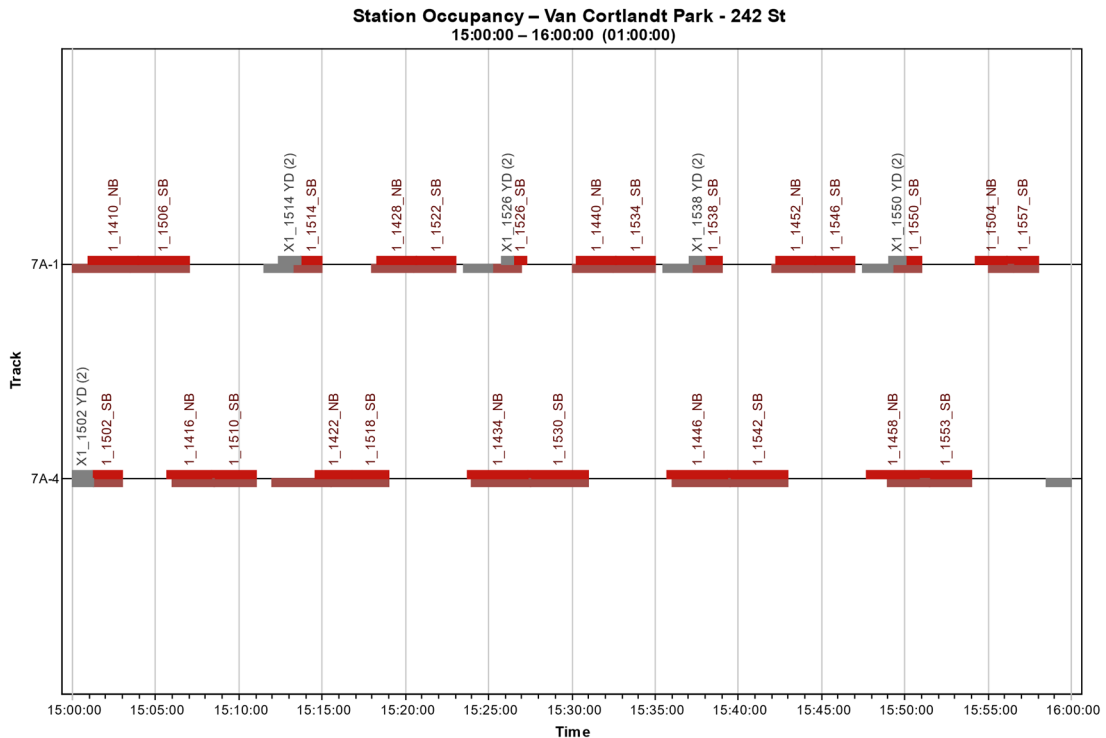


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**Figure G.5-76: Future Baseline (CBTC) Station Occupancy Chart –
Van Cortlandt Park-242 Street – 9:00 to 10:00 a.m.**



**Figure G.5-77: Future Baseline (CBTC) Station Occupancy Chart –
Van Cortlandt Park-242 Street – 3:00 to 4:00 p.m.**



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Figure G.5-78: Future Baseline (CBTC) Station Occupancy Chart –
Van Cortlandt Park-242 Street – 4:00 to 5:00 p.m.

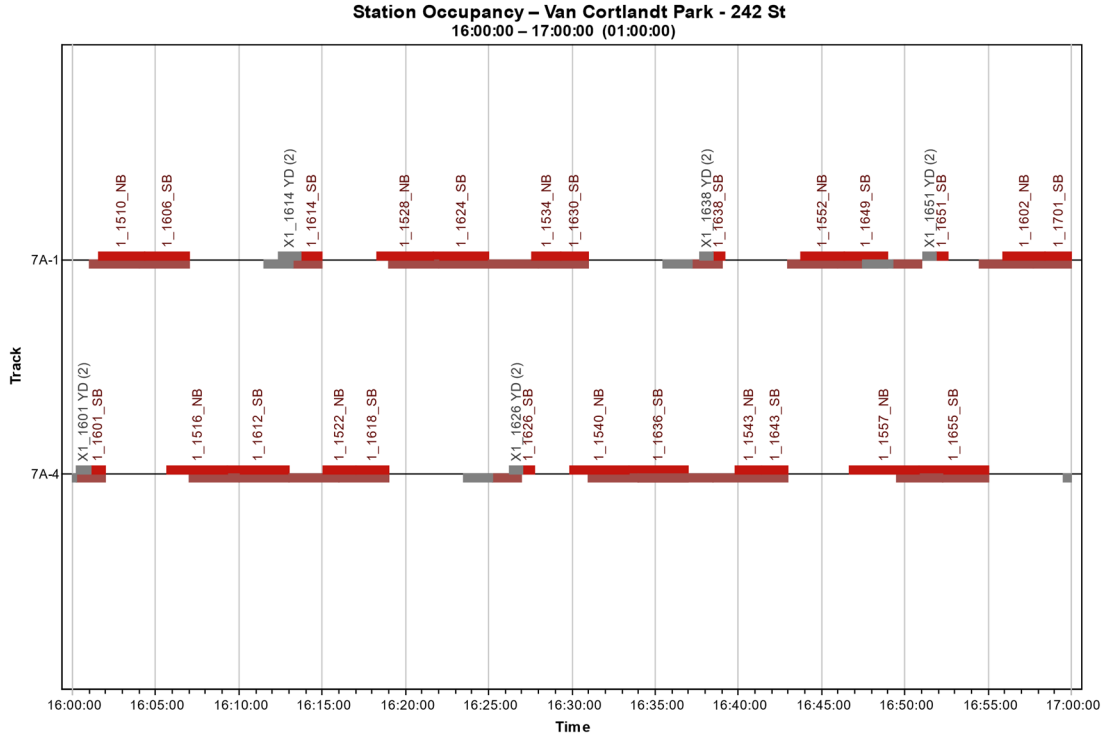
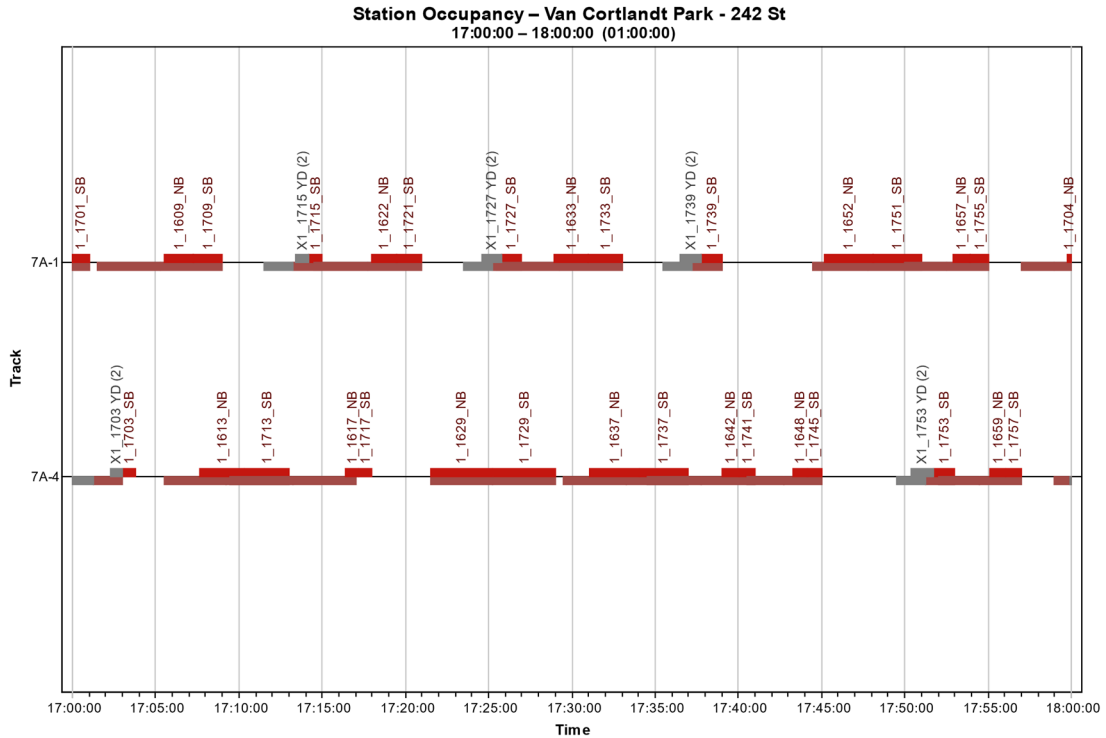
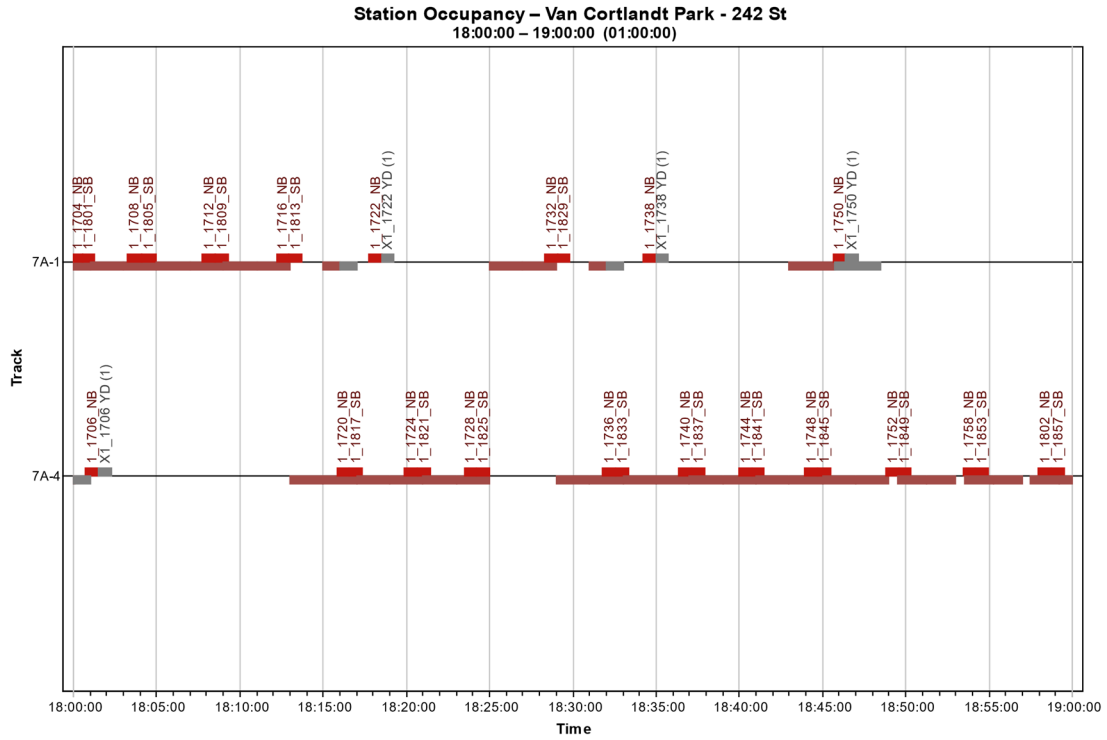


Figure G.5-79: Future Baseline (CBTC) Station Occupancy Chart –
Van Cortlandt Park-242 Street – 5:00 to 6:00 p.m.



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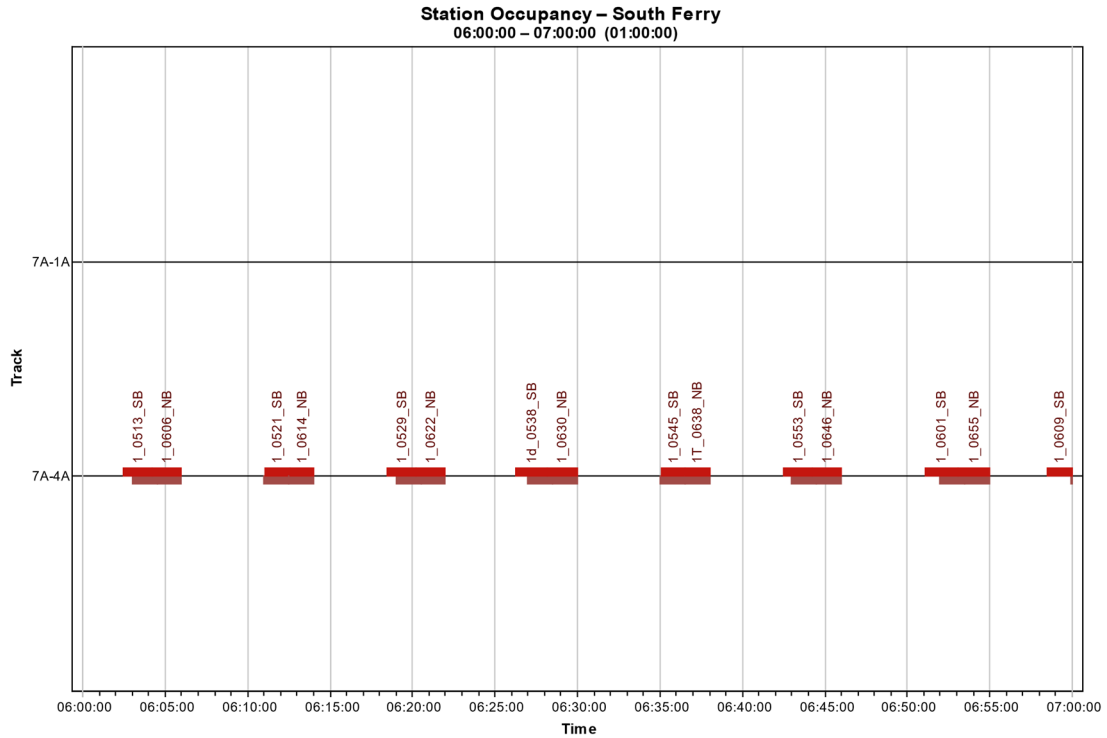
Figure G.5-80: Future Baseline (CBTC) Station Occupancy Chart –
Van Cortlandt Park-242 Street – 6:00 to 7:00 p.m.



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G.5.11 South Ferry

Figure G.5-81: Future Baseline (CBTC) Station Occupancy Chart –
South Ferry – 6:00 to 7:00 a.m.



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Figure G.5-82: Future Baseline (CBTC) Station Occupancy Chart –
South Ferry – 7:00 to 8:00 a.m.

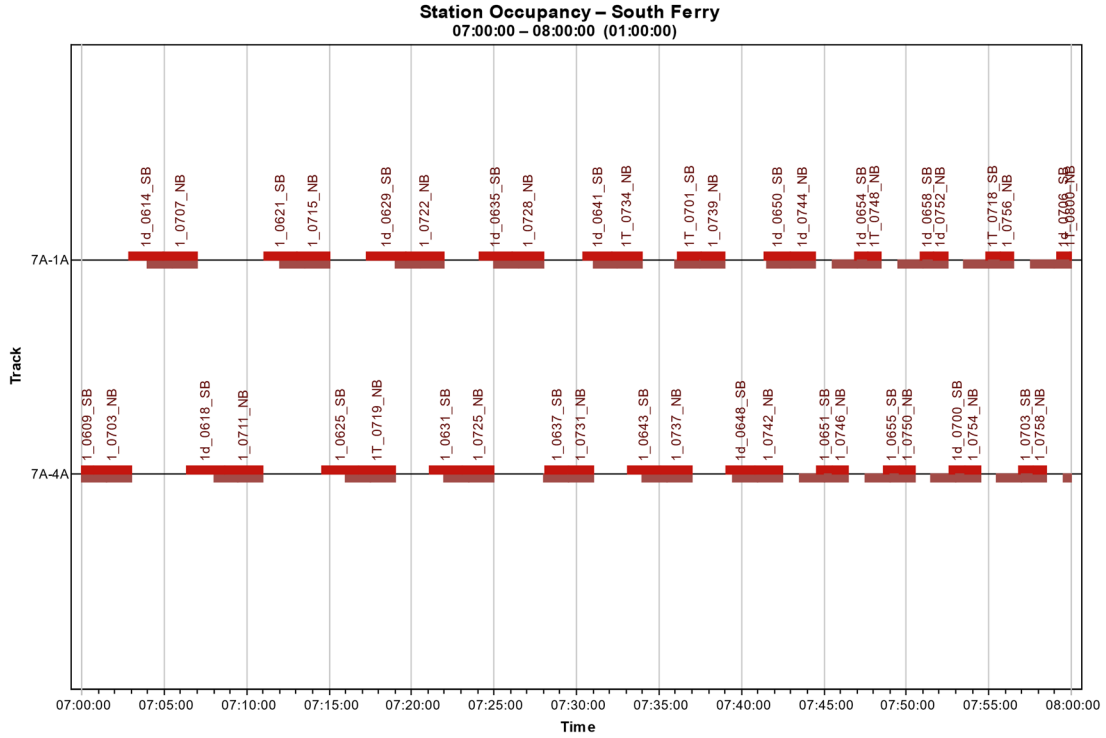
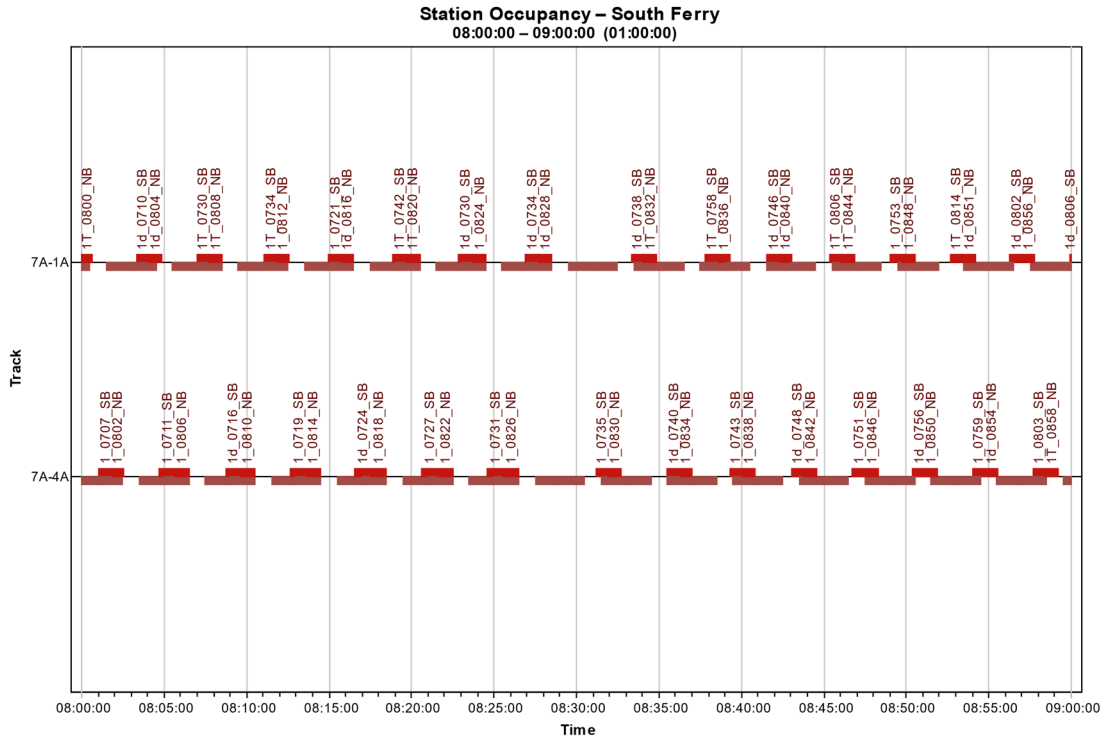


Figure G.5-83: Future Baseline (CBTC) Station Occupancy Chart –
South Ferry – 8:00 to 9:00 a.m.



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Figure G.5-84: Future Baseline (CBTC) Station Occupancy Chart –
South Ferry – 9:00 to 10:00 a.m.

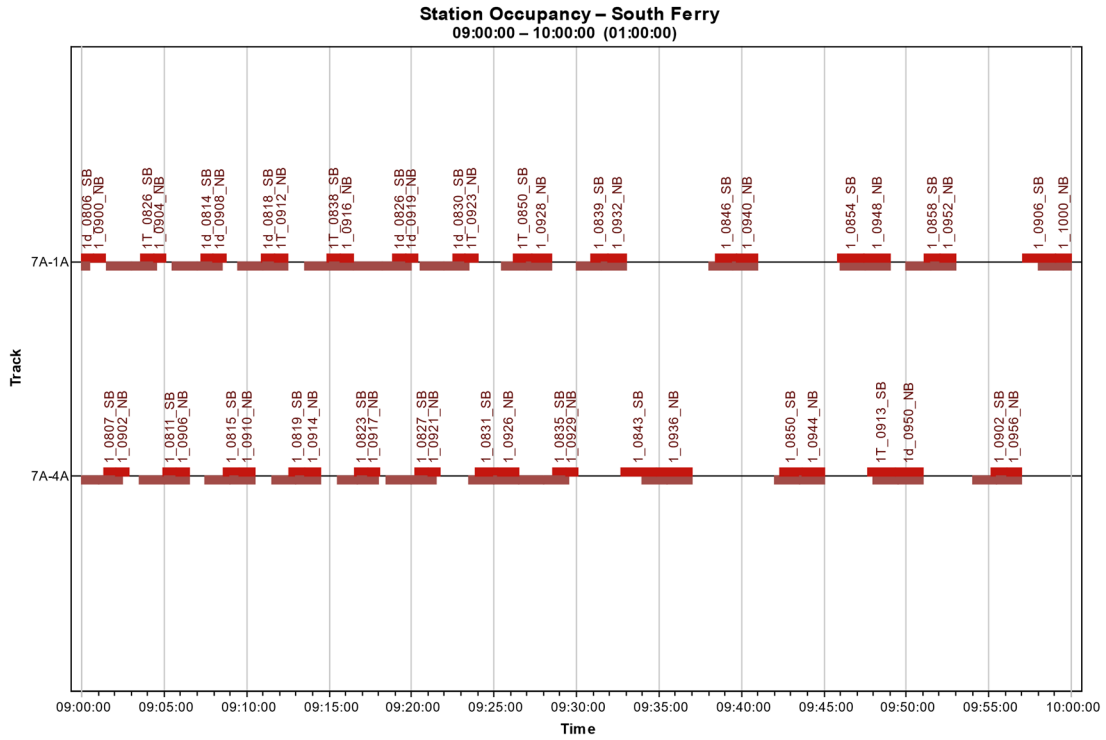
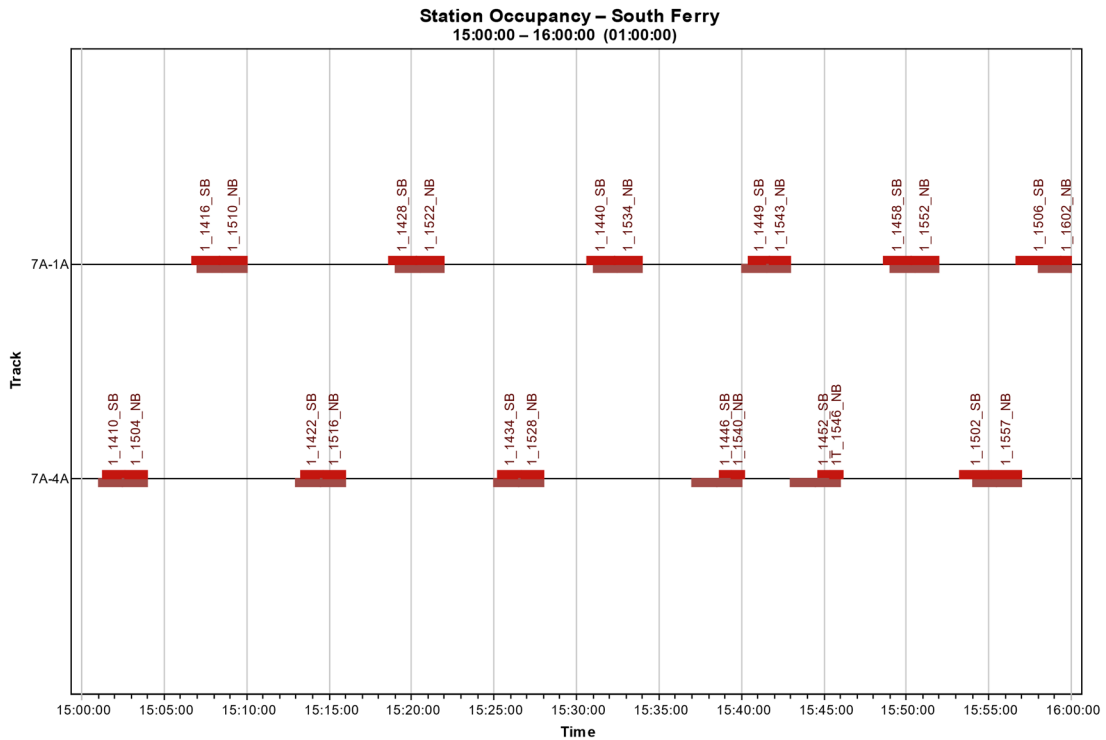


Figure G.5-85: Future Baseline (CBTC) Station Occupancy Chart –
South Ferry – 3:00 to 4:00 p.m.



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Figure G.5-86: Future Baseline (CBTC) Station Occupancy Chart –
South Ferry – 4:00 to 5:00 p.m.

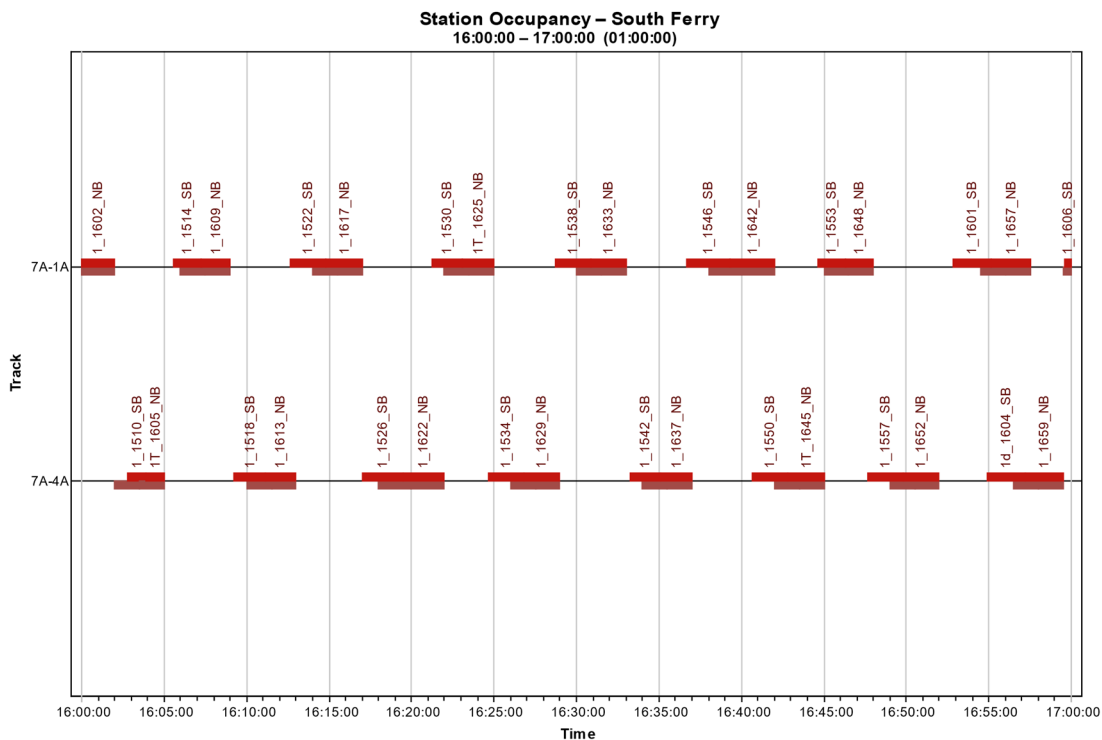
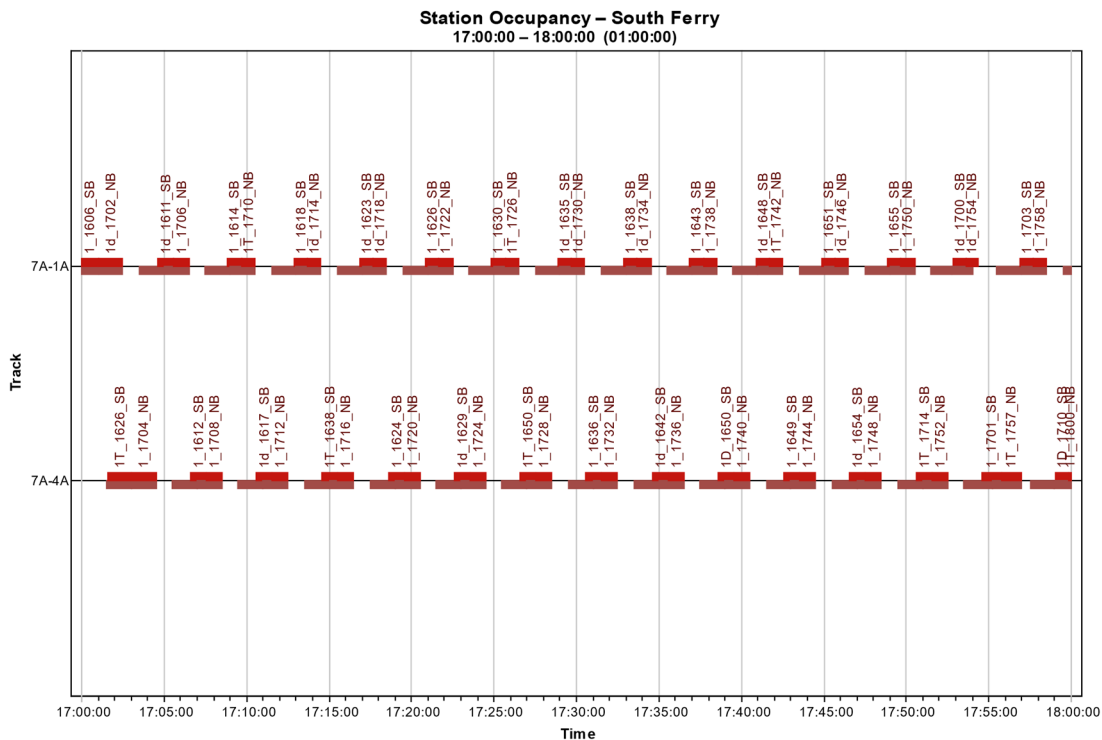
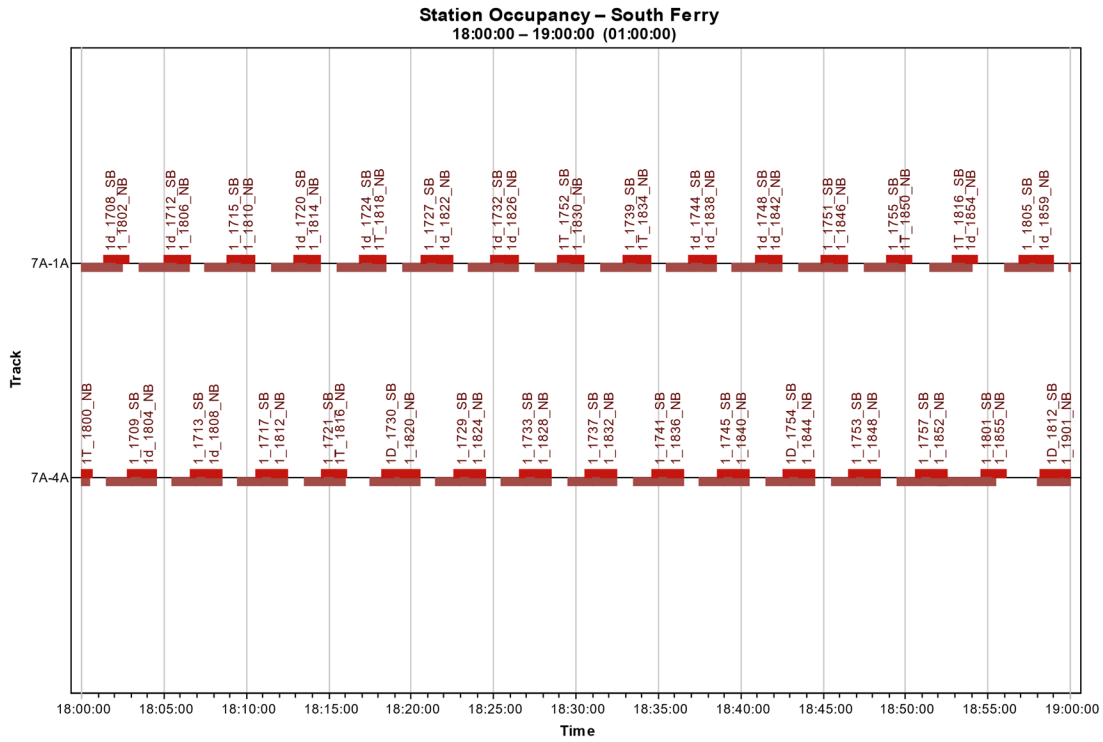


Figure G.5-87: Future Baseline (CBTC) Station Occupancy Chart –
South Ferry – 5:00 to 6:00 p.m.



APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.5-88. Future Baseline (CBTC) Station Occupancy Chart – South Ferry – 6:00 to 7:00 p.m.



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G.6 Simulated Wayside and CBTC Travel Times, Phases I and II

Figure G.6-1. 2 Line Northbound, Flatbush Avenue to Nevins Street

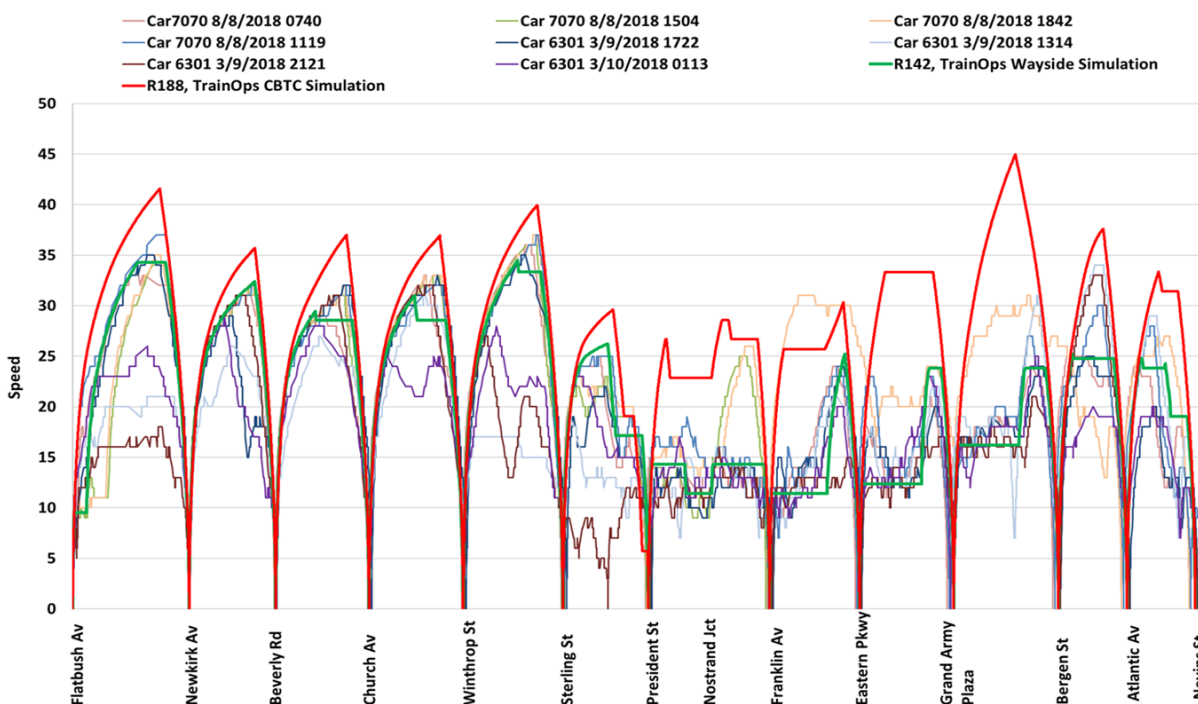
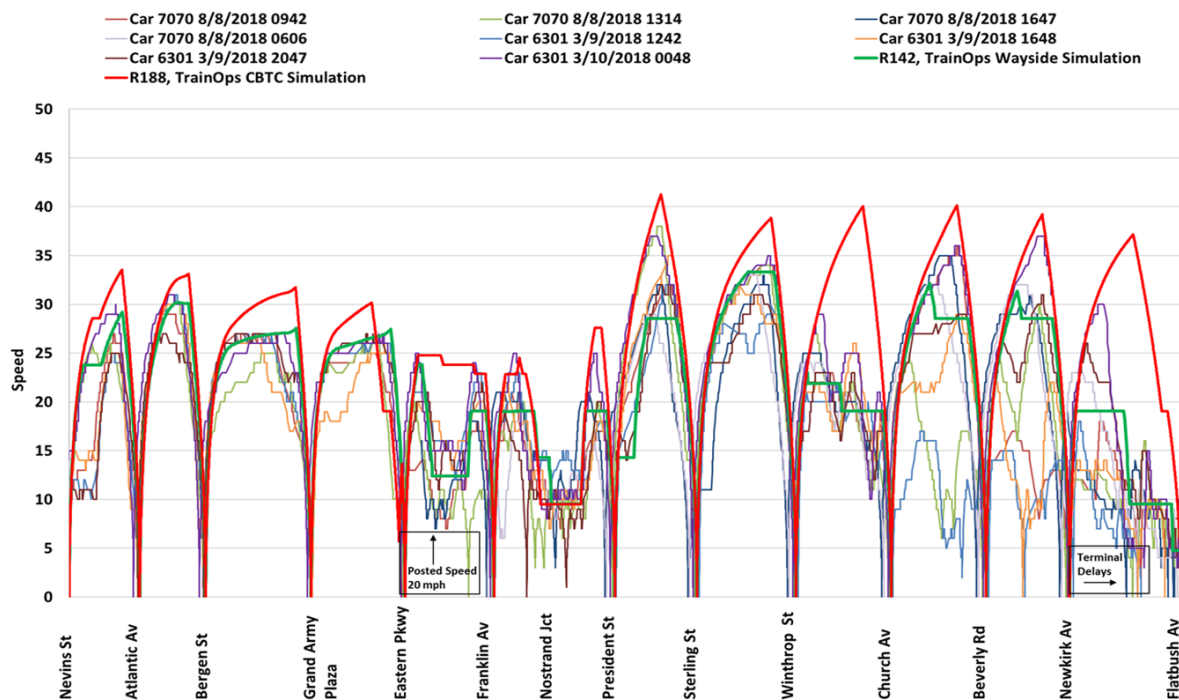


Figure G.6-2. 2 Line Southbound, Nevins Street to Flatbush Avenue



APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.6-3. ④ Line Northbound, New Lots Avenue to Utica Avenue

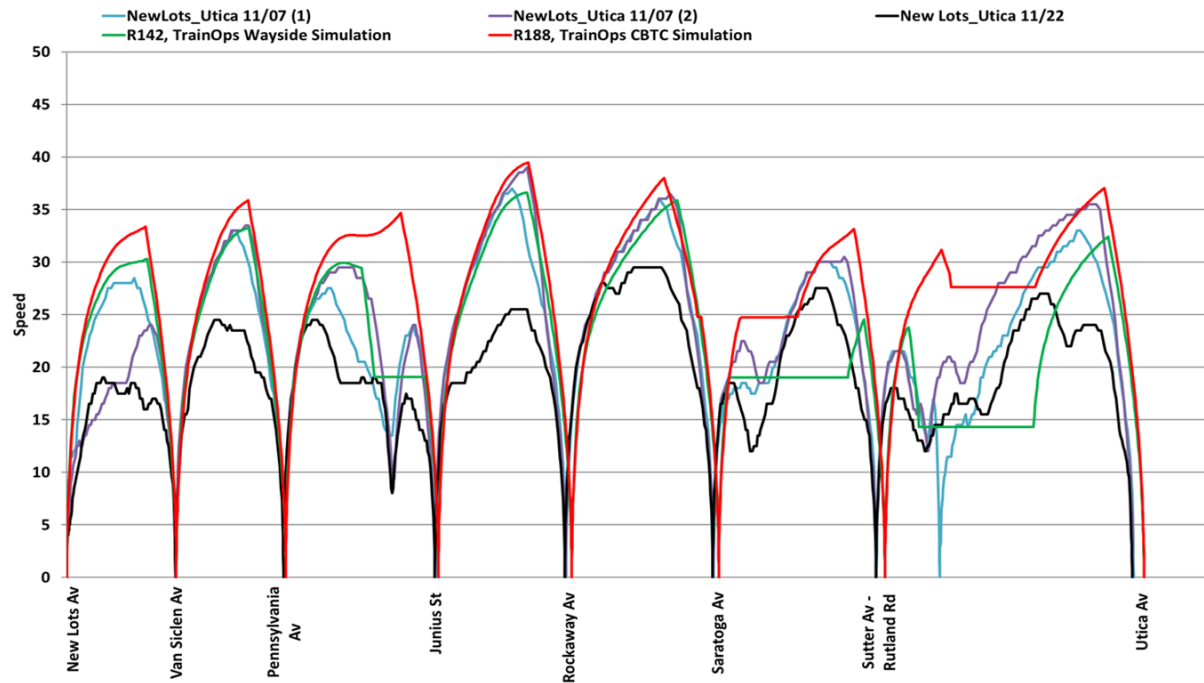
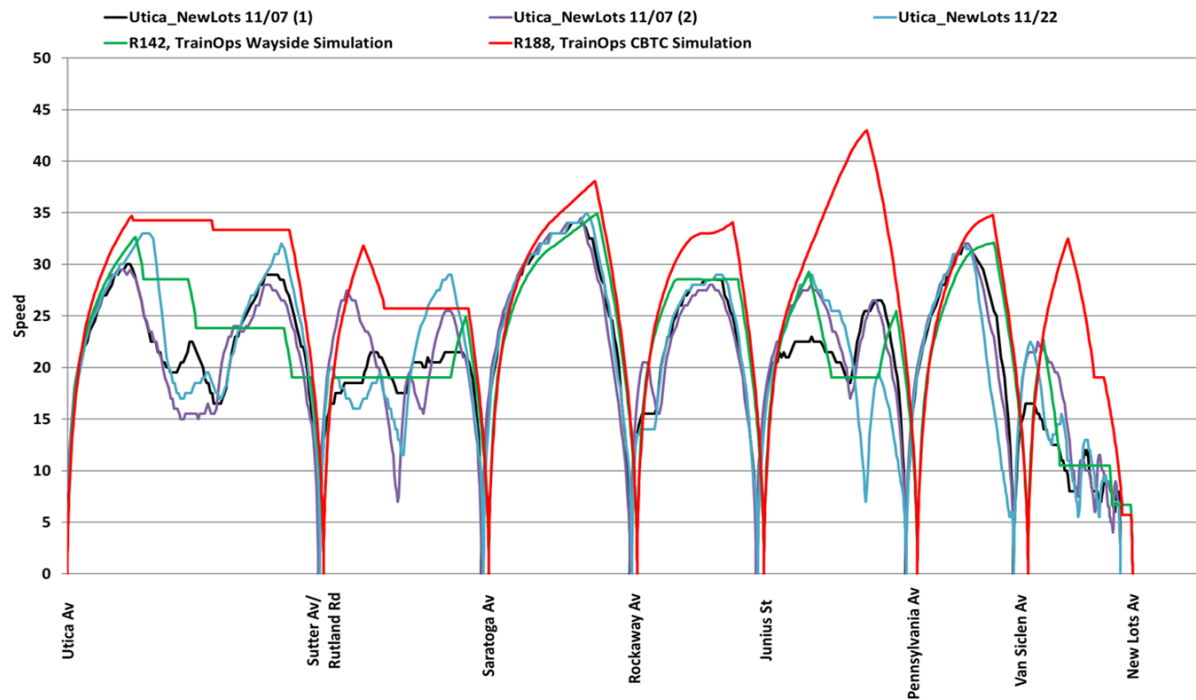


Figure G.6-4. ④ Line Southbound, Utica Avenue to New Lots Avenue



APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.6-5. ③ Line Southbound, Utica Avenue to New Lots Avenue

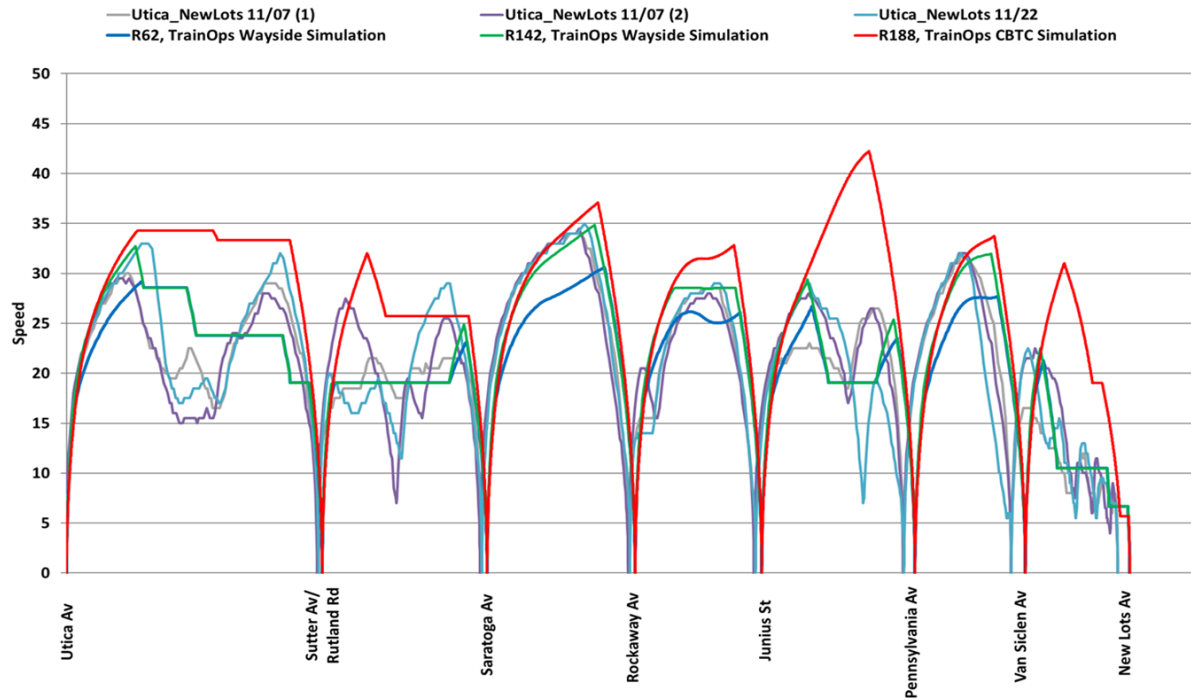
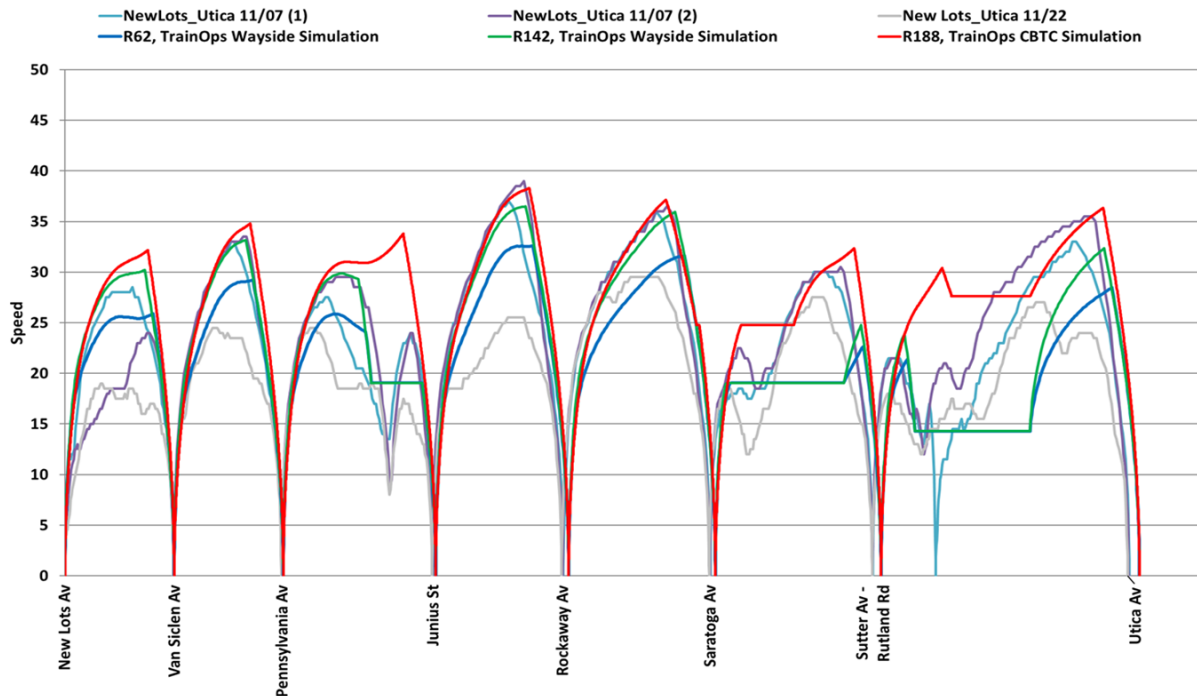


Figure G.6-6. ③ Line Northbound, New Lots Avenue to Utica Avenue



APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Figure G.6-7. 4 Line Southbound, 138 Street to Utica Avenue

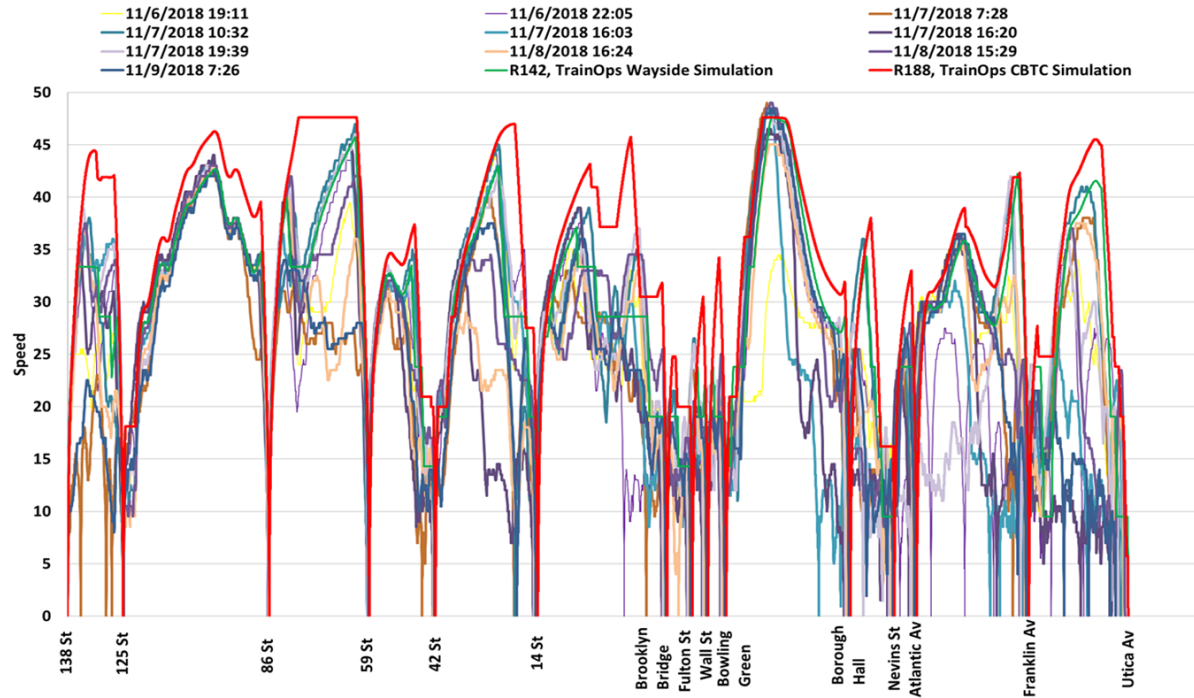
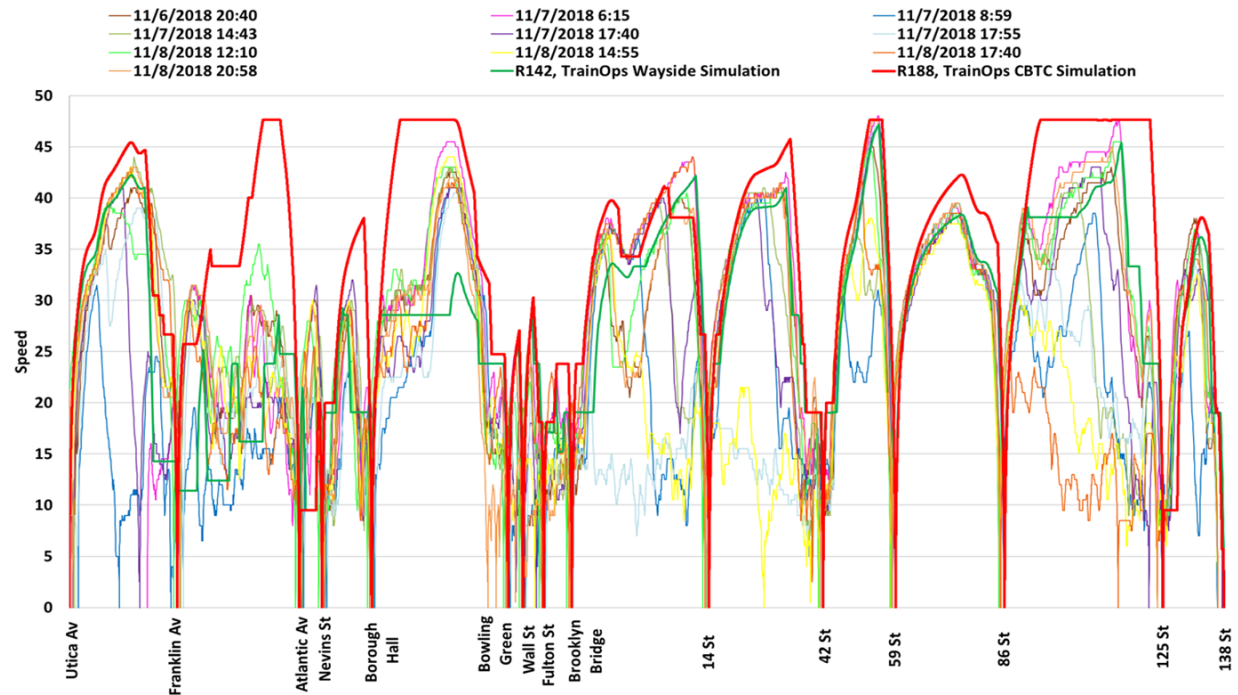


Figure G.6-8. 4 Line Northbound, Utica Avenue to 138 Street



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**APPENDICES TO FUTURE BASELINE (CBTC)
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G.7 Present and Potential Capacity Constraints: Future Baseline (CBTC) Model

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TECHNICAL MEMORANDUM**

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APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.7-1. Capacity Constraints, Future Baseline (CBTC) Model, Morning Peak

Line	Track	Direction	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity	Volume/ Capacity
Broadway	7A-1	S	Van Cortlandt Park/242 St	238 St	1	18					18	26	69%
Broadway	7A-4	N	238 St	Van Cortlandt Park/ 242 St	1	18					18	26	69%
Broadway	7A-1	S	238 St	Dyckman St	1	26					26	36	72%
Broadway	7A-4	N	Dyckman St	238 St	1	26					26	36	72%
Broadway	7A-1	S	Dyckman St	145 St	1	26					26	36	72%
Broadway	7A-4	N	145 St	Dyckman St	1	26					26	36	72%
Broadway	7A-1	S	145 St	137 St	1	26					26	36	72%
Broadway	7A-4	N	137 St	145 St	1	26					26	36	72%
Broadway	7A-1	S	137 St	103 St	1	30					30	36	83%
Broadway	7A-4	N	103 St	137 St	1	30					30	36	83%
Broadway	7A-1	S	103 St	Times Sq/42 St	1	30					30	36	83%
Broadway	7A-4	N	Times Sq/42 St	103 St	1	30					30	36	83%
7th Avenue	7A-1	S	Times Sq/42 St	Chambers St	1	30					30	36	83%
7th Avenue	7A-4	N	Chambers St	Times Sq/42 St	1	30					30	36	83%
7th Avenue	7A-1	S	Chambers St	South Ferry Terminal	1	30					30	36	83%
7th Avenue	7A-4	N	South Ferry Terminal	Chambers St	1	30					30	36	83%
Lenox Avenue	LN-1	S	Harlem/148 St	145 St	3	13					13	16	81%
Lenox Avenue	LN-4	N	145 St	Harlem/148 St	3	13					13	16	81%
Lenox Avenue	LN-1	S	145 St	142 St Jct	3	13					13	36	36%
Lenox Avenue	LN-4	N	142 St Jct	145 St	3	13					13	18	72%
Lenox Avenue	7A-2-LN-2	S	142 St Jct	Central Park North (110 St)	2 3	26					26	36	72%
Lenox Avenue	7A-3-LN-3	N	Central Park North (110 St)	142 St Jct	2 3	26					26	36	72%
Lenox Avenue	7A-2-LN-2	S	Central Park North (110 St)	103 St	2 3	26					26	36	72%
Lenox Avenue	7A-3-LN-3	N	103 St	Central Park North (110 St)	2 3	26					26	36	72%
Broadway	7A-2-LN-2	S	103 St	Times Sq/42 St	2 3	26					26	36	72%
Broadway	7A-3-LN-3	N	Times Sq/42 St	103 St	2 3	26					26	36	72%
7th Avenue	7A-2-LN-2	S	Times Sq/42 St	Chambers St	2 3	26					26	36	72%
7th Avenue	7A-3-LN-3	N	Chambers St	Times Sq/42 St	2 3	26					26	36	72%
7th Avenue	7A-2-LN-2	S	Chambers St	Park St	2 3	26					26	36	72%
7th Avenue	7A-3-LN-3	N	Park St	Chambers St	2 3	26					26	36	72%

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.7-1. Capacity Constraints, Future Baseline (CBTC) Model, Morning Peak

Line	Track	Direction	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity	Volume/ Capacity
Clark Street	7A-2-LN-2	S	Park St	Fulton St	2 3	26					26	36	72%
Clark Street	7A-3-LN-3	N	Fulton St	Park St	2 3	26					26	36	72%
Clark Street	7A-2-LN-2	S	Fulton St	Hoyt St	2 3	26					26	36	72%
7th Avenue	7A-3-LN-3	N	Hoyt St	Fulton St	2 3	26					26	36	72%
Eastern Parkway	EP-E1	S	Hoyt St	Franklin Av	2 3	26					26	36	72%
Eastern Parkway	EP-E4	N	Franklin Av	Hoyt St	2 3	26					26	36	72%
Eastern Parkway	EP-E1	S	Franklin Av	Nostrand Jct	2 3	26					26	36	72%
Eastern Parkway	EP-E4	N	Nostrand Jct	Franklin Av	2 3	26					26	36	72%
Eastern Parkway	EP-E1	S	Nostrand Jct	Van Siclen Av	3	13					13	36	36%
Eastern Parkway	EP-E4	N	Van Siclen Av	Nostrand Av	3	13					13	36	36%
Eastern Parkway	EP-E1	S	Van Siclen Av	New Lots Av	3	13					13	23	57%
Eastern Parkway	EP-E4	N	New Lots Av	Van Siclen Av	3	13					13	23	57%
White Plains Road	WP-2	S	Wakefield/241 St	Nereid Av	2	13					13	21	62%
White Plains Road	WP-3	N	Nereid Av	Wakefield/241 St	2	13					13	21	62%
White Plains Road	WP-2	S	Nereid Av	Bronx Park East	2	13					13	36	36%
White Plains Road	WP-3	N	Bronx Park East	Nereid Av	2	13	5	4			17	36	47%
White Plains Road	WP-2	S	Bronx Park East	E 180 St	2	13					13	36	36%
White Plains Road	WP-3	N	E 180 St	Bronx Park East	2	13	5	4			17	36	47%
Lenox Av/White Plains Rd	WP-2	S	E 180 St	West Farms Sq/ E Tremont Av	2	13	5	10			23	36	64%
Lenox Av/White Plains Rd	WP-M	N	West Farms Sq/ E Tremont Av	E 180 St	5	12					12	36	33%
Lenox Av/White Plains Rd	WP-3	N	West Farms Sq/E Tremont Av	E 180 St	2	13					13	36	36%
Lenox Av/White Plains Rd	WP-2	S	West Farms Sq/E Tremont Av	3 Av/149 St	2	13	5	10			23	36	64%
Lenox Av/White Plains Rd	WP-M	N	3 Av/149 St	West Farms Sq/ E Tremont Av	5	12					12	36	33%
Lenox Av/White Plains Rd	WP-3	N	3 Av/149 St	West Farms Sq/ E Tremont Av	2	13					13	36	36%
Lenox Av	WP-2	S	3 Av/149 St	149 St/Grand Concourse	2	13	5	10			23	24	96%
Lenox Av	WP-3	N	149 St/Grand Concourse	3 Av/149 St	2	13					13	24	54%
Lenox Av	7A-2-LN-2	S	149 St/Grand Concourse	142 St Jct	2	13					13	18	72%
Lenox Av	7A-3-LN-3	N	142 St Jct	149 St/Grand Concourse	2	13					13	18	72%
Eastern Parkway	EP-E1	S	Nostrand Jct	Nostrand Jct	2 3	26	5	10			36	36	100%
Eastern Parkway	EP-E4	N	Nostrand Jct	Nostrand Jct	2	13	3	13	5	10	36	36	100%
Nostrand Avenue	NO-D2	S	Nostrand Jct	Newkirk Av	2	13	5	10			23	23	100%
Nostrand Avenue	NO-D3	N	Newkirk Av	Nostrand Jct	2	13	5	10			23	23	100%

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.7-1. Capacity Constraints, Future Baseline (CBTC) Model, Morning Peak

Line	Track	Direction	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity	Volume/ Capacity
Nostrand Avenue	NO-D2	S	Newkirk Av	Flatbush Av/Brooklyn College	2	13	5	10			23	31	74%
Nostrand Avenue	NO-D3	N	Flatbush Av/Brooklyn College	Newkirk Av	2	13	5	10			23	31	74%
Jerome Avenue	JR-1	S	Woodlawn	Mosholu Pkwy	4	20					20	26	77%
Jerome Avenue	JR-4	N	Mosholu Pkwy	Woodlawn	4	20					20	26	77%
Jerome Avenue	JR-1	S	Mosholu Pkwy	Bedford Park Blvd/Lehman College	4	20					20	26	77%
Jerome Avenue	JR-4	N	Bedford Park Blvd/Lehman College	Mosholu Pkwy	4	20					20	26	77%
Jerome Avenue	JR-1	S	Bedford Park Blvd/Lehman College	149 St/Grand Concourse	4	20					20	36	56%
Jerome Avenue	JR-4	N	149 St/Grand Concourse	Bedford Park Blvd/Lehman College	4	20					20	36	56%
Jerome Avenue	JR-1	S	149 St/Grand Concourse	138 St/Grand Concourse	4	20					20	36	56%
Jerome Avenue	LX-4-JR-4	N	North of 138 St	149 St/Grand Concourse	4	20					20	36	56%
Lexington Avenue	LX-4-JR-4	N	138 St/Grand Concourse	North of 138 St	4 5	30					30	36	83%
Lexington Avenue	LX-3-PE-3	N	125 St	138 St/Grand Concourse	4 5	30					30	36	83%
Lexington Avenue	LX-2-PE-2	S	116 St	110 St	4 5	30					30	36	83%
Lexington Avenue	LX-2-PE-2	S	110 St	103 St	4 5	30					30	36	83%
Lexington Avenue	LX-2-PE-2	S	103 St	51 St	4 5	30					30	36	83%
Lexington Avenue	LX-3-PE-3	N	51 St	125 St	4 5	30					30	36	83%
Lexington Avenue	EP-2-LX-2	S	51 St	Grand Central/42 St	4 5	30					30	36	83%
Lexington Avenue	EP-2-LX-2	S	Grand Central/42 St	14 St/Union Sq	4 5	30					30	30	100%
Lexington Avenue	EP-E3-LX-3	N	Grand Central/42 St	51 St	4 5	30					30	30	100%
Lexington Avenue	EP-2-LX-2	S	14 St/Union Sq	Brooklyn Bridge	4 5	30					30	30	100%
Lexington Avenue	EP-E3-LX-3	N	14 St/Union Sq	Grand Central/42 St	4 5	30					30	30	100%
Lexington Avenue	EP-2-LX-2	S	Brooklyn Bridge	Bowling Green	4 5	30					30	36	83%
Lexington Avenue	EP-E3-LX-3	N	Brooklyn Bridge	14 St/Union Sq	4 5	30					30	30	100%
Lexington Avenue	EP-E3-LX-3	N	Bowling Green	Brooklyn Bridge	4 5	30					30	36	83%
Lexington Avenue	EP-2-LX-2	S	Bowling Green	Hoyt St	4 5	30					30	36	83%
Eastern Parkway	EP-E3-LX-3	N	Hoyt St	Bowling Green	4 5	30					30	36	83%
Eastern Parkway	EP-2-LX-2	S	Hoyt St	Franklin Av	4 5	30					30	36	83%
Eastern Parkway	EP-E3-LX-3	N	Franklin Av	Hoyt St	4 5	30					30	36	83%
Eastern Parkway	EP-2-LX-2	S	Franklin Av	Nostrand Jct	4 5	30					30	36	83%
Eastern Parkway	EP-E3-LX-3	N	Nostrand Jct	Franklin Av	4 5	30					30	36	83%
Eastern Parkway	EP-2-LX-2	S	Nostrand Jct	Nostrand Av	4	20					20	36	56%
Eastern Parkway	EP-E3-LX-3	N	Nostrand Av	Nostrand Jct	4	20					20	36	56%

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Table G.7-1. Capacity Constraints, Future Baseline (CBTC) Model, Morning Peak

Line	Track	Direction	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity	Volume/ Capacity
Eastern Parkway	EP-2-LX-2	S	Nostrand Av	Crown Hts/Utica Av	4	20					20	27	74%
Eastern Parkway	EP-E3-LX-3	N	Crown Hts/Utica Av	Kingston Av	4	20					20	27	74%
Dyre Avenue	DY-1	S	Eastchester/Dyre Av	Baychester Av	5	10					10	29	34%
Dyre Avenue	DY-2	N	Baychester Av	Eastchester/Dyre Av	5	8					8	29	28%
Dyre Avenue	DY-1	S	Baychester Av	Morris Park	5	10					10	36	28%
Dyre Avenue	DY-2	N	Morris Park	Baychester Av	5	8					8	36	22%
Dyre Avenue	DY-1	S	Morris Park	E 180 St	5	10					10	36	28%
Dyre Avenue	DY-2	N	E 180 St	Morris Park	5	8					8	36	22%
Dyre Avenue	WP-1A	S	149 St/ Grand Concourse	North of 138 St	5	10					10	18	56%
Dyre Avenue	WP-4A	N	138 St/Grand Concourse	149 St/Grand Concourse	5	12					12	18	67%
Lexington Avenue	LX-1-JR-1	S	North of 138 St	138 St/Grand Concourse	5	10					10	18	56%
Pelham	PE-2	S	Pelham Bay Park	Westchester Sq/ E Tremont Av	6	15					15	28	54%
Pelham	PE-3	N	Westchester Sq/ E Tremont Av	Pelham Bay Park	6	15					15	28	54%
Pelham	PE-2	S	Westchester Sq/ E Tremont Av	Castle Hill Av	6	30					30	36	83%
Pelham	PE-3	N	Castle Hill Av	Westchester Sq/ E Tremont Av	6	15					15	36	42%
Pelham	PE-M	N	Castle Hill Av	Westchester Sq/ E Tremont Av	6	15					15	36	42%
Pelham	PE-2	S	Castle Hill Av	Brook Av	6	30					30	36	83%
Pelham	PE-3	N	Brook Av	Castle Hill Av	6	15					15	36	42%
Pelham	PE-M	N	Brook Av	Castle Hill Av	6	15					15	36	42%
Pelham	PE-2	S	Brook Av	3 Av/138 St	6	30					30	36	83%
Pelham	PE-3	N	3 Av/138 St	Brook Av	6	15					15	36	42%
Pelham	PE-M	N	3 Av/138 St	Brook Av	6	15					15	36	42%
Lexington Avenue	LX-2-PE-2	S	3 Av/138 St	125 St	6	30					30	36	83%
Lexington Avenue	LX-3A-125	N	125 St	3 Av/138 St	6	30					30	36	83%
Lexington Avenue	LX-1-JR-1	S	125 St	116 St	6	30					30	36	83%
Lexington Avenue	LX-1-JR-1	S	116 St	51 St	6	30					30	36	83%
Lexington Avenue	LX-4-JR-4	N	51 St	125 St	6	30					30	36	83%
Lexington Avenue	LX-1-JR-1	S	51 St	Grand Central/42 St	6	30					30	36	83%
Lexington Avenue	LX-4-JR-4	N	Grand Central/42 St	51 St	6	30					30	36	83%
Lexington Avenue	LX-1-JR-1	S	Grand Central/42 St	Grand Central South Interlocking	6	30					30	36	83%
Lexington Avenue	LX-4-JR-4	N	14 St/Union Sq	Grand Central/42 St	6	30					30	36	83%
Lexington Avenue	LX-1-JR-1	S	Grand Central South Interlocking	14 St/Union Sq	6	30					30	36	83%

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.7-1. Capacity Constraints, Future Baseline (CBTC) Model, Morning Peak

Line	Track	Direction	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity	Volume/ Capacity
Lexington Avenue	LX-1-JR-1	S	14 St/Union Sq	Brooklyn Bridge	6	30					30	36	83%
Lexington Avenue	LX-4-JR-4	N	Brooklyn Bridge	14 St/Union Sq	6	30					30	36	83%
Lexington Avenue	LX-4-JR-4	S	Brooklyn Bridge South	Brooklyn Bridge North	6	30					30	30	100%
42nd Street Shuttle	42-S-1	S/N	Times Sq Shuttle	Grand Central Shuttle	S	10					10	10	100%
42nd Street Shuttle	42-S-4	S/N	Times Sq Shuttle	Grand Central Shuttle	S	10					10	10	100%

Notes:

1. Capacity is shown on a segment-specific basis. Available capacity may not be usable given constraints elsewhere in the network for a given service.
2. Times Sq-Grand Central service delivery and capacity reflect one-way operation. Bidirectional service delivery on each track is double the train volumes shown.

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.7-2. Capacity Constraints, Future Baseline (CBTC) Model, Evening Peak

Line	Track	Direction	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity	Volume/ Capacity
Broadway	7A-1	S	Van Cortlandt Park/242 St	238 St	1	15					15	26	58%
Broadway	7A-4	N	238 St	Van Cortlandt Park/ 242 St	1	15					15	26	58%
Broadway	7A-1	S	238 St	Dyckman St	1	25					25	36	69%
Broadway	7A-4	N	Dyckman St	238 St	1	25					25	36	69%
Broadway	7A-1	S	Dyckman St	145 St	1	25					25	36	69%
Broadway	7A-4	N	145 St	Dyckman St	1	25					25	36	69%
Broadway	7A-1	S	145 St	137 St	1	25					25	36	69%
Broadway	7A-4	N	137 St	145 St	1	27					27	36	75%
Broadway	7A-1	S	137 St	103 St	1	30					30	36	83%
Broadway	7A-4	N	103 St	137 St	1	30					30	36	83%
Broadway	7A-1	S	103 St	Times Sq/42 St	1	30					30	36	83%
Broadway	7A-4	N	Times Sq/42 St	103 St	1	30					30	36	83%
7th Avenue	7A-1	S	Times Sq/42 St	Chambers St	1	30					30	36	83%
7th Avenue	7A-4	N	Chambers St	Times Sq/42 St	1	30					30	36	83%
7th Avenue	7A-1	S	Chambers St	South Ferry Terminal	1	30					30	36	83%
7th Avenue	7A-4	N	South Ferry Terminal	Chambers St	1	30					30	36	83%
Lenox Avenue	LN-1	S	Harlem/148 St	145 St	3	13					13	16	81%
Lenox Avenue	LN-4	N	145 St	Harlem/148 St	3	14					14	16	88%
Lenox Avenue	LN-1	S	145 St	142 St Jct	3	13					13	36	36%
Lenox Avenue	LN-4	N	142 St Jct	145 St	3	14					14	18	78%
Lenox Avenue	7A-2-LN-2	S	142 St Jct	Central Park North (110 St)	2 3	27					27	36	75%
Lenox Avenue	7A-3-LN-3	N	Central Park North (110 St)	142 St Jct	2 3	27					27	36	75%
Lenox Avenue	7A-2-LN-2	S	Central Park North (110 St)	103 St	2 3	27					27	36	75%
Lenox Avenue	7A-3-LN-3	N	103 St	Central Park North (110 St)	2 3	27					27	36	75%
Broadway	7A-2-LN-2	S	103 St	Times Sq/42 St	2 3	27					27	36	75%
Broadway	7A-3-LN-3	N	Times Sq/42 St	103 St	2 3	27					27	36	75%
7th Avenue	7A-2-LN-2	S	Times Sq/42 St	Chambers St	2 3	27					27	36	75%
7th Avenue	7A-3-LN-3	N	Chambers St	Times Sq/42 St	2 3	27					27	36	75%
7th Avenue	7A-2-LN-2	S	Chambers St	Park St	2 3	27					27	36	75%
7th Avenue	7A-3-LN-3	N	Park St	Chambers St	2 3	27					27	36	75%
Clark Street	7A-2-LN-2	S	Park St	Fulton St	2 3	27					27	36	75%
Clark Street	7A-3-LN-3	N	Fulton St	Park St	2 3	27					27	36	75%

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.7-2. Capacity Constraints, Future Baseline (CBTC) Model, Evening Peak

Line	Track	Direction	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity	Volume/ Capacity
Clark Street	7A-2-LN-2	S	Fulton St	Hoyt St	2 3	27					27	36	75%
7th Avenue	7A-3-LN-3	N	Hoyt St	Fulton St	2 3	27					27	36	75%
Eastern Parkway	EP-E1	S	Hoyt St	Franklin Av	2 3	27					27	36	75%
Eastern Parkway	EP-E4	N	Franklin Av	Hoyt St	2 3	27					27	36	75%
Eastern Parkway	EP-E1	S	Franklin Av	Nostrand Jct	2 3	27					27	36	75%
Eastern Parkway	EP-E4	N	Nostrand Jct	Franklin Av	2 3	27					27	36	75%
Eastern Parkway	EP-E1	S	Nostrand Jct	Van Siclen Av	3	14					14	36	39%
Eastern Parkway	EP-E4	N	Van Siclen Av	Nostrand Av	3	14					14	36	39%
Eastern Parkway	EP-E1	S	Van Siclen Av	New Lots Av	3	14					14	23	61%
Eastern Parkway	EP-E4	N	New Lots Av	Van Siclen Av	3	14					14	23	61%
White Plains Road	WP-2	S	Wakefield/241 St	Nereid Av	2	13					13	21	62%
White Plains Road	WP-3	N	Nereid Av	Wakefield/241 St	2	13					13	21	62%
White Plains Road	WP-2	S	Nereid Av	Bronx Park East	2	13	5	4			17	36	47%
White Plains Road	WP-3	N	Bronx Park East	Nereid Av	2	13					13	36	36%
White Plains Road	WP-2	S	Bronx Park East	E 180 St	2	13	5	4			17	36	47%
White Plains Road	WP-3	N	E 180 St	Bronx Park East	2	13					13	36	36%
Lenox Av/White Plains Rd	WP-2	S	E 180 St	West Farms Sq/ E Tremont Av	2	13					13	36	36%
Lenox Av/White Plains Rd	WP-M	S	E 180 St	West Farms Sq/ E Tremont Av	5	11					11	36	31%
Lenox Av/White Plains Rd	WP-3	N	West Farms Sq/E Tremont Av	E 180 St	2	13	5	10			23	36	64%
Lenox Av/White Plains Rd	WP-2	S	West Farms Sq/E Tremont Av	3 Av/149 St	2	13					13	36	36%
Lenox Av/White Plains Rd	WP-M	S	West Farms Sq/E Tremont Av	3 Av/149 St	5	11					11	36	31%
Lenox Av/White Plains Rd	WP-3	N	3 Av/149 St	West Farms Sq/ E Tremont Av	2	13	5	10			23	36	64%
Lenox Av	WP-2	S	3 Av/149 St	149 St/Grand Concourse	2	13	5	11			24	24	100%
Lenox Av	WP-3	N	149 St/Grand Concourse	3 Av/149 St	2	13	5	10			23	24	96%
Lenox Av	7A-2-LN-2	S	149 St/Grand Concourse	142 St Jct	2	13					13	18	72%
Lenox Av	7A-3-LN-3	N	142 St Jct	149 St/Grand Concourse	2	13					13	18	72%
Eastern Parkway	EP-E1	S	Nostrand Jct	Nostrand Jct	2 3	27	5	10			37	36	103%
Eastern Parkway	EP-E4	N	Nostrand Jct	Nostrand Jct	2	13	3	14	5	10	37	36	103%
Nostrand Avenue	NO-D2	S	Nostrand Jct	Newkirk Av	2	13	5	10			23	23	100%
Nostrand Avenue	NO-D3	N	Newkirk Av	Nostrand Jct	2	13	5	10			23	23	100%
Nostrand Avenue	NO-D2	S	Newkirk Av	Flatbush Av/Brooklyn College	2	13	5	10			23	31	74%
Nostrand Avenue	NO-D3	N	Flatbush Av/Brooklyn College	Newkirk Av	2	13	5	10			23	31	74%

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.7-2. Capacity Constraints, Future Baseline (CBTC) Model, Evening Peak

Line	Track	Direction	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity	Volume/ Capacity
Jerome Avenue	JR-1	S	Woodlawn	Mosholu Pkwy	4	21					21	26	81%
Jerome Avenue	JR-4	N	Mosholu Pkwy	Woodlawn	4	21					21	26	81%
Jerome Avenue	JR-1	S	Mosholu Pkwy	Bedford Park Blvd/Lehman College	4	21					21	26	81%
Jerome Avenue	JR-4	N	Bedford Park Blvd/Lehman College	Mosholu Pkwy	4	21					21	26	81%
Jerome Avenue	JR-1	S	Bedford Park Blvd/Lehman College	149 St/Grand Concourse	4	21					21	36	58%
Jerome Avenue	JR-4	N	149 St/Grand Concourse	Bedford Park Blvd/Lehman College	4	21					21	36	58%
Jerome Avenue	JR-1	S	149 St/Grand Concourse	138 St/Grand Concourse	4	21					21	36	58%
Jerome Avenue	LX-4-JR-4	N	North of 138 St	149 St/Grand Concourse	4	21					21	36	58%
Lexington Avenue	LX-4-JR-4	N	138 St/Grand Concourse	North of 138 St	4 5	30					30	36	83%
Lexington Avenue	LX-3-PE-3	N	125 St	138 St/Grand Concourse	4 5	30					30	36	83%
Lexington Avenue	LX-2-PE-2	S	116 St	110 St	4 5	30					30	36	83%
Lexington Avenue	LX-2-PE-2	S	110 St	103 St	4 5	30					30	36	83%
Lexington Avenue	LX-2-PE-2	S	103 St	51 St	4 5	30					30	36	83%
Lexington Avenue	LX-3-PE-3	N	51 St	125 St	4 5	30					30	36	83%
Lexington Avenue	EP-2-LX-2	S	51 St	Grand Central/42 St	4 5	30					30	36	83%
Lexington Avenue	EP-2-LX-2	S	Grand Central/42 St	14 St/Union Sq	4 5	30					30	30	100%
Lexington Avenue	EP-E3-LX-3	N	Grand Central/42 St	51 St	4 5	30					30	30	100%
Lexington Avenue	EP-2-LX-2	S	14 St/Union Sq	Brooklyn Bridge	4 5	30					30	30	100%
Lexington Avenue	EP-E3-LX-3	N	14 St/Union Sq	Grand Central/42 St	4 5	30					30	30	100%
Lexington Avenue	EP-2-LX-2	S	Brooklyn Bridge	Bowling Green	4 5	30					30	36	83%
Lexington Avenue	EP-E3-LX-3	N	Brooklyn Bridge	14 St/Union Sq	4 5	30					30	30	100%
Lexington Avenue	EP-E3-LX-3	N	Bowling Green	Brooklyn Bridge	4 5	30					30	36	83%
Lexington Avenue	EP-2-LX-2	S	Bowling Green	Hoyt St	4 5	30					30	36	83%
Eastern Parkway	EP-E3-LX-3	N	Hoyt St	Bowling Green	4 5	30					30	36	83%
Eastern Parkway	EP-2-LX-2	S	Hoyt St	Franklin Av	4 5	30					30	36	83%
Eastern Parkway	EP-E3-LX-3	N	Franklin Av	Hoyt St	4 5	30					30	36	83%
Eastern Parkway	EP-2-LX-2	S	Franklin Av	Nostrand Jct	4 5	30					30	36	83%
Eastern Parkway	EP-E3-LX-3	N	Nostrand Jct	Franklin Av	4 5	30					30	36	83%
Eastern Parkway	EP-2-LX-2	S	Nostrand Jct	Nostrand Av	4	20					20	36	56%
Eastern Parkway	EP-E3-LX-3	N	Nostrand Av	Nostrand Jct	4	20					20	36	56%
Eastern Parkway	EP-2-LX-2	S	Nostrand Av	Crown Hts/Utica Av	4	20					20	27	74%
Eastern Parkway	EP-E3-LX-3	N	Crown Hts/Utica Av	Kingston Av	4	20					20	27	74%

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.7-2. Capacity Constraints, Future Baseline (CBTC) Model, Evening Peak

Line	Track	Direction	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity	Volume/ Capacity
Dyre Avenue	DY-1	S	Eastchester/Dyre Av	Baychester Av	5	8					8	29	28%
Dyre Avenue	DY-2	N	Baychester Av	Eastchester/Dyre Av	5	10					10	29	34%
Dyre Avenue	DY-1	S	Baychester Av	Morris Park	5	8					8	36	22%
Dyre Avenue	DY-2	N	Morris Park	Baychester Av	5	10					10	36	28%
Dyre Avenue	DY-1	S	Morris Park	E 180 St	5	8					8	36	22%
Dyre Avenue	DY-2	N	E 180 St	Morris Park	5	10					10	36	28%
Dyre Avenue	WP-1A	S	149 St/ Grand Concourse	North of 138 St	5	11					11	18	61%
Dyre Avenue	WP-4A	N	138 St/Grand Concourse	149 St/Grand Concourse	5	10					10	18	56%
Lexington Avenue	LX-1-JR-1	S	North of 138 St	138 St/Grand Concourse	5	11					11	18	61%
Pelham	PE-2	S	Pelham Bay Park	Westchester Sq/ E Tremont Av	6	17					17	28	61%
Pelham	PE-3	N	Westchester Sq/ E Tremont Av	Pelham Bay Park	6	15					15	28	54%
Pelham	PE-2	S	Westchester Sq/ E Tremont Av	Castle Hill Av	6	17					17	36	47%
Pelham	PE-3	N	Castle Hill Av	Westchester Sq/ E Tremont Av	6	30					30	36	83%
Pelham	PE-M	S	Westchester Sq/ E Tremont Av	Castle Hill Av	6	13					13	36	36%
Pelham	PE-2	S	Castle Hill Av	Brook Av	6	15					15	36	42%
Pelham	PE-3	N	Brook Av	Castle Hill Av	6	30					30	36	83%
Pelham	PE-M	S	Castle Hill Av	Brook Av	6	15					15	36	42%
Pelham	PE-2	S	Brook Av	3 Av/138 St	6	15					15	36	42%
Pelham	PE-3	N	3 Av/138 St	Brook Av	6	30					30	36	83%
Pelham	PE-M	S	Brook Av	3 Av/138 St	6	15					15	36	42%
Lexington Avenue	LX-2-PE-2	S	3 Av/138 St	125 St	6	30					30	36	83%
Lexington Avenue	LX-3A-125	N	125 St	3 Av/138 St	6	30					30	36	83%
Lexington Avenue	LX-1-JR-1	S	125 St	116 St	6	30					30	36	83%
Lexington Avenue	LX-1-JR-1	S	116 St	51 St	6	30					30	36	83%
Lexington Avenue	LX-4-JR-4	N	51 St	125 St	6	30					30	36	83%
Lexington Avenue	LX-1-JR-1	S	51 St	Grand Central/42 St	6	30					30	36	83%
Lexington Avenue	LX-4-JR-4	N	Grand Central/42 St	51 St	6	30					30	36	83%
Lexington Avenue	LX-1-JR-1	S	Grand Central/42 St	Grand Central South Interlocking	6	30					30	36	83%
Lexington Avenue	LX-4-JR-4	N	14 St/Union Sq	Grand Central/42 St	6	30					30	36	83%
Lexington Avenue	LX-1-JR-1	S	Grand Central South Interlocking	14 St/Union Sq	6	30					30	36	83%
Lexington Avenue	LX-1-JR-1	S	14 St/Union Sq	Brooklyn Bridge	6	30					30	36	83%
Lexington Avenue	LX-4-JR-4	N	Brooklyn Bridge	14 St/Union Sq	6	30					30	36	83%

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.7-2. Capacity Constraints, Future Baseline (CBTC) Model, Evening Peak

Line	Track	Direction	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity	Volume/ Capacity
Dyre Avenue	DY-1	S	Eastchester/Dyre Av	Baychester Av	5	8					8	29	28%
Dyre Avenue	DY-2	N	Baychester Av	Eastchester/Dyre Av	5	10					10	29	34%
Dyre Avenue	DY-1	S	Baychester Av	Morris Park	5	8					8	36	22%
Dyre Avenue	DY-2	N	Morris Park	Baychester Av	5	10					10	36	28%
Dyre Avenue	DY-1	S	Morris Park	E 180 St	5	8					8	36	22%
Dyre Avenue	DY-2	N	E 180 St	Morris Park	5	10					10	36	28%
Dyre Avenue	WP-1A	S	149 St/ Grand Concourse	North of 138 St	5	11					11	18	61%
Dyre Avenue	WP-4A	N	138 St/Grand Concourse	149 St/Grand Concourse	5	10					10	18	56%
Lexington Avenue	LX-1-JR-1	S	North of 138 St	138 St/Grand Concourse	5	11					11	18	61%
Pelham	PE-2	S	Pelham Bay Park	Westchester Sq/ E Tremont Av	6	17					17	28	61%
Pelham	PE-3	N	Westchester Sq/ E Tremont Av	Pelham Bay Park	6	15					15	28	54%
Pelham	PE-2	S	Westchester Sq/ E Tremont Av	Castle Hill Av	6	17					17	36	47%
Pelham	PE-3	N	Castle Hill Av	Westchester Sq/ E Tremont Av	6	30					30	36	83%
Pelham	PE-M	S	Westchester Sq/ E Tremont Av	Castle Hill Av	6	13					13	36	36%
Pelham	PE-2	S	Castle Hill Av	Brook Av	6	15					15	36	42%
Pelham	PE-3	N	Brook Av	Castle Hill Av	6	30					30	36	83%
Pelham	PE-M	S	Castle Hill Av	Brook Av	6	15					15	36	42%
Pelham	PE-2	S	Brook Av	3 Av/138 St	6	15					15	36	42%
Pelham	PE-3	N	3 Av/138 St	Brook Av	6	30					30	36	83%
Pelham	PE-M	S	Brook Av	3 Av/138 St	6	15					15	36	42%
Lexington Avenue	LX-2-PE-2	S	3 Av/138 St	125 St	6	30					30	36	83%
Lexington Avenue	LX-3A-125	N	125 St	3 Av/138 St	6	30					30	36	83%
Lexington Avenue	LX-1-JR-1	S	125 St	116 St	6	30					30	36	83%
Lexington Avenue	LX-1-JR-1	S	116 St	51 St	6	30					30	36	83%
Lexington Avenue	LX-4-JR-4	N	51 St	125 St	6	30					30	36	83%
Lexington Avenue	LX-1-JR-1	S	51 St	Grand Central/42 St	6	30					30	36	83%
Lexington Avenue	LX-4-JR-4	N	Grand Central/42 St	51 St	6	30					30	36	83%
Lexington Avenue	LX-1-JR-1	S	Grand Central/42 St	Grand Central South Interlocking	6	30					30	36	83%
Lexington Avenue	LX-4-JR-4	N	14 St/Union Sq	Grand Central/42 St	6	30					30	36	83%
Lexington Avenue	LX-1-JR-1	S	Grand Central South Interlocking	14 St/Union Sq	6	30					30	36	83%
Lexington Avenue	LX-1-JR-1	S	14 St/Union Sq	Brooklyn Bridge	6	30					30	36	83%
Lexington Avenue	LX-4-JR-4	N	Brooklyn Bridge	14 St/Union Sq	6	30					30	36	83%

APPENDICES TO FUTURE BASELINE (CBTC) TECHNICAL MEMORANDUM

Table G.7-2. Capacity Constraints, Future Baseline (CBTC) Model, Evening Peak

Line	Track	Direction	From Station	To Station	Service 1	TPH	Service 2	TPH	Service 3	TPH	Total TPH	Capacity	Volume/ Capacity
Lexington Avenue	LX-4-JR-4	S	Brooklyn Bridge South	Brooklyn Bridge North	6	30					30	30	100%
42nd Street Shuttle	42-S-1	S/N	Times Sq Shuttle	Grand Central Shuttle	S	10					10	10	100%
42nd Street Shuttle	42-S-4	S/N	Times Sq Shuttle	Grand Central Shuttle	S	10					10	10	100%

Notes:

1. Capacity is shown on a segment-specific basis. Available capacity may not be usable given constraints elsewhere in the network for a given service.
2. Times Sq-Grand Central service delivery and capacity reflect one-way operation. Bidirectional service delivery on each track is double the train volumes shown.



IRT CAPACITY STUDY

1 2 3 4 5 6 S LINES

H - APPENDICES TO CAPACITY SENSITIVITY ANALYSIS



Prepared for:



by:
STV
July 2020

APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

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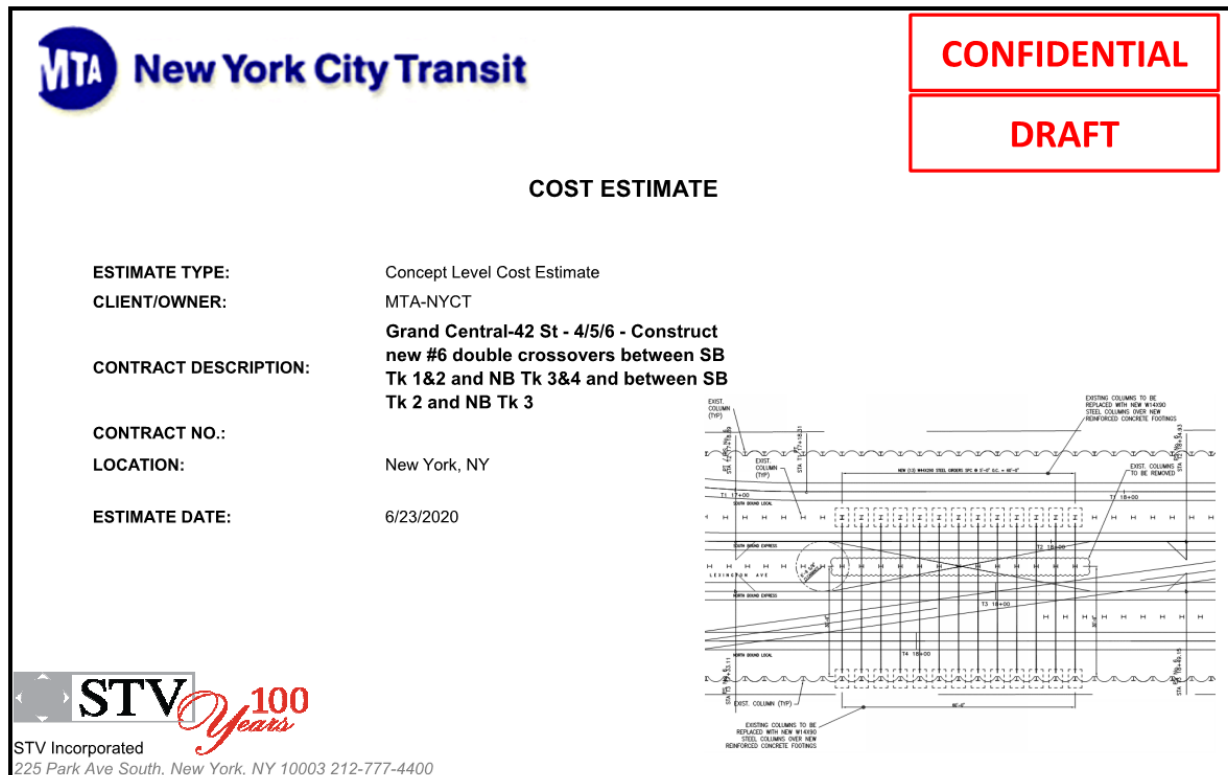
APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

H.0 Revision History – Not Applicable

H.1 Budgetary Construction Cost Estimates and Schedules

H.1.1 New Split Interlocking North of Grand Central – 42 Street Station

Table H.1-1. Budgetary Construction Cost Estimate, Grand Central – 42 Street



APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

COST ESTIMATE SUMMARY			MTA-NYCT	
Contract No:			Grand Central-42 St - 4/5/6	
Location:				
ESTIMATE SUMMARY				
Item No.	Description		Total Cost	
1	Construct new #6 double crossovers between SB Tk 1&2 and NB Tk 3&4 and between SB Tk 2 and NB Tk 3		\$ 34,309,897	
2				
3	Total Direct Cost		\$ 34,309,897	
4	General Conditions	10%	\$ 3,430,990	
5	Subtotal		\$ 37,740,886	
6	Overhead & Profit	15%	\$ 5,661,133	
7	Subtotal		\$ 43,402,019	
8	Bonds & Insurance	2%	\$ 868,040	
9	Subtotal		\$ 44,270,060	
10	Escalation - Excluded	0%	\$ -	
11	Subtotal		\$ 44,270,060	
12	Contingency	30%	\$ 13,281,018	
13	Total - Construction		\$ 57,551,078	
14	TA Support Labor	55%	\$ 31,653,093	
15	Total Estimated Cost		\$ 89,204,170	

APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

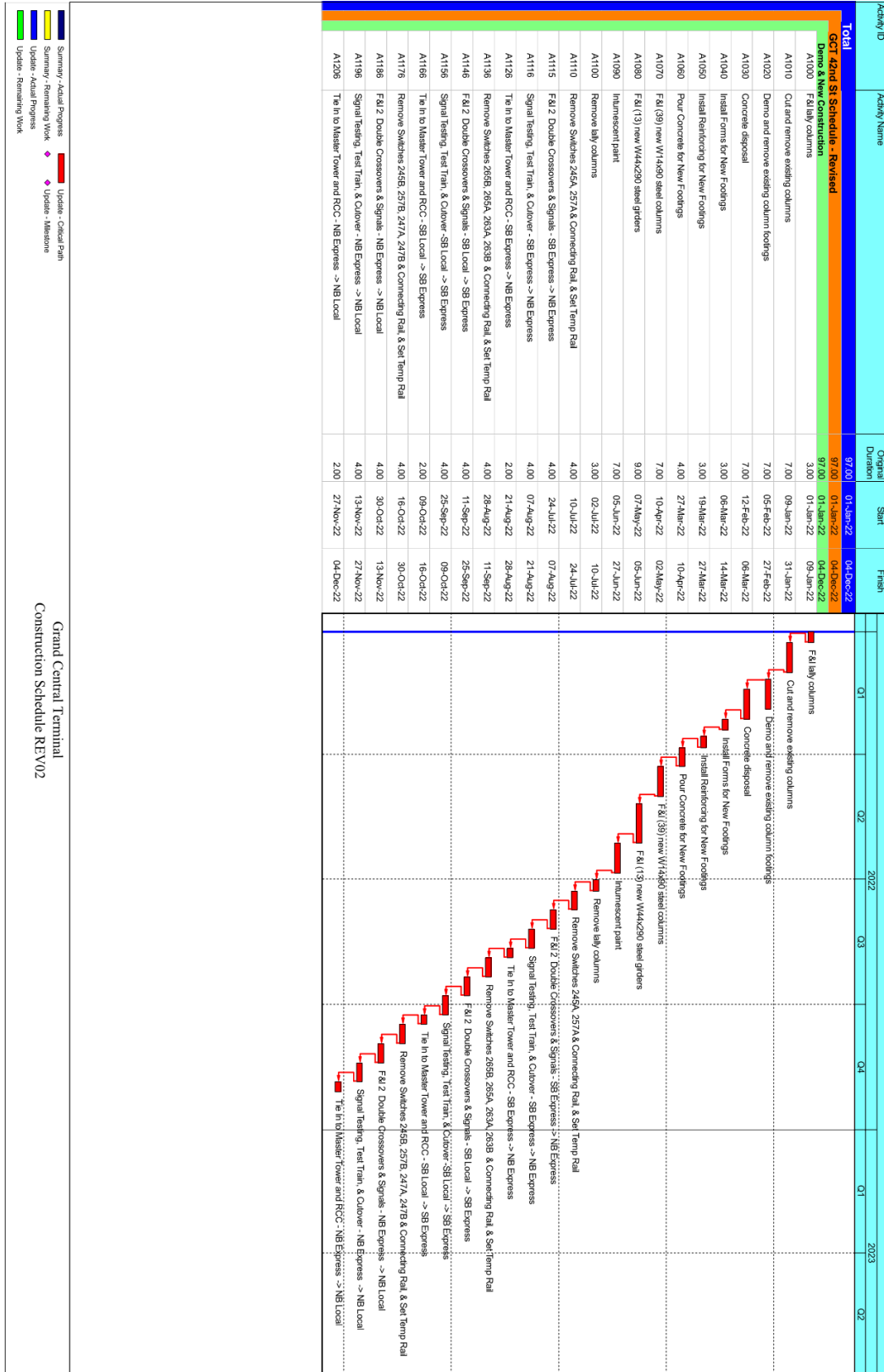
COST ESTIMATE			MTA-NYCT Grand Central-42 St - 4/5/6		
CONTRACT:					
LOCATION:					
Concept Level Cost Estimate					
ITEM NO.	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
1	Demolition & New Construction - Based on 55-Hr Weekend Track Outages				
2	General Requirements	6%			\$1,242,925
3	F&I lally columns	39	EA	\$10,100.00	\$393,900
4	Cut and remove existing columns	39	EA	\$16,100.00	\$627,900
5	Demo and remove existing column footings - say 1-cy per ftg	39	CY	\$5,600.00	\$218,400
6	Concrete disposal	39	CY	\$4,900.00	\$191,100
7	F&I new column footings				
8	Forms	1,360	SF	\$170.00	\$231,188
9	Reinforcing	6,435	LBS	\$40.00	\$257,400
10	Concrete	43	CY	\$4,800.00	\$205,920
11	F&I (39) new W14x90 steel columns - say 15-ft each	55,283	LBS	\$20.00	\$1,105,650
12	F&I (13) new W44x290 steel girders - say 42'-7" each	168,553	LBS	\$20.00	\$3,371,059
13	Intumescent paint	11,007	SF	\$70.00	\$770,493
14	Remove lally columns	39	EA	\$8,100.00	\$315,900
15	Remove switches 245A, 257A & Connecting Rail, & Set Temp Rail	1	LS	\$386,000.00	\$386,000
16	F&I#6 Double Crossover & Signals - SB Express - NB Express	1	EA	\$2,182,000.00	\$2,182,000
17	Signal Testing & Cutover - SB Express - NB Express	1	LS	\$486,000.00	\$486,000
18	Tie-in to Master Tower & RCC - SB Express - NB Express	1	LS	\$193,000.00	\$193,000
19	Remove switches 265B, 265A,263A,263B & Connecting Rail, & Set Temp Rail	1	LS	\$486,000.00	\$486,000
20	F&I#6 Double Crossover & Signals - SB Local - SB Express	1	EA	\$2,182,000.00	\$2,182,000
21	Signal Testing & Cutover - SB Local - SB Express	1	LS	\$486,000.00	\$486,000
22	Tie-in to Master Tower & RCC - SB Local - SB Express	1	LS	\$193,000.00	\$193,000
23	Remove switches 245B, 257B,247A,247B & Connecting Rail, & Set Temp Rail	1	LS	\$486,000.00	\$486,000
24	F&I#6 Double Crossover & Signals - NB Express - NB Local	1	EA	\$2,182,000.00	\$2,182,000
25	Signal Testing & Cutover - SB Local - NB Local	1	LS	\$486,000.00	\$486,000
26	Tie-in to Master Tower & RCC - NB Express - NB Local	1	LS	\$193,000.00	\$193,000
27					
28	Work trains - allowance for 97-weekend shifts	97	EA	\$10,300.00	\$999,100
29	Field Supervisor - allowance	1	LS	\$200,000.00	\$200,000
30	Test trains - allowance for 12-weekend shifts	36	EA	\$20,000.00	\$720,000
31	Signal gang - allowance for 12-weekend shifts	36	SHIFTS	\$28,000.00	\$1,008,000
32	Flaggers - allowance for 12-weekend shifts	36	SHIFTS	\$4,400.00	\$158,400
33	Subtotal				\$21,958,334

COST ESTIMATE			MTA-NYCT Grand Central-42 St - 4/5/6		
CONTRACT:					
LOCATION:					
Concept Level Cost Estimate					
ITEM NO.	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
34	Existing Logistics	25%			\$5,489,583
35	Subtotal				\$27,447,917
36	Phasing/Staging	25%			\$6,861,979
37	Total Direct Cost				\$34,309,897

The foregoing budgetary estimate does not include "soft costs" or NYCT costs other than those indicated. This estimate is based on the following conceptual schedule and schedule assumptions.

APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

Figure H.1-1. Conceptual Construction Schedule, Grand Central – 42 Street



APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

H.1.1.1 Grand Central – 42 Street Schedule Assumptions and Risks

- a. Because of the confined space concurrent work will not be able to take place. All work is taking place sequentially.
- b. Work is taking place on a 55-hour weekend calendar. A one-day duration in the schedule is equal to one weekend day, with three 8-hour shifts per day.
- c. Concrete disposal will take place continuously while demolition and removal of columns is taking place.
- d. The sequence of construction for the installation of the double crossovers is as follows:
 1. Removal of switches & connection rail will take place first, followed by the installation of temporary rail. Next, the double crossovers and signals will be furnished and installed. This will be followed by signal testing, a test train, and final cutover. The sequence of construction will conclude with a tie-in to the master tower and Rail Control Center.
 2. The work will commence at Tracks 2 and 3 because of the structural work taking place at that location. The track work at Tracks 1 and 2 will follow. The construction sequence will conclude with the work at Tracks 3 and 4.
- e. The project's assumptions pertaining to production rates are as follows:
 1. Installation of Lally columns will have a production rate of 12 Lally columns per weekend shift.*
 2. Cutting and removing the existing columns will have a production rate of 6 columns per weekend shift.*
 3. Demolition and removal of existing column footings will have a production rate of 6 columns per weekend shift.*
 4. Concrete disposal will take place continuously as the demo work progresses.
 5. 420 SF** of forms will be placed for the new footings in one weekend shift.*
 6. Reinforcing steel will be placed in the forms for the new footings at a rate of 2000 LBS*** per weekend shift.*
 7. The concrete will be poured into the new footing forms at a rate of 12 CY**** per weekend shift.*
 8. The steel columns will be installed at a rate of 6 steel columns per weekend shift.*
 9. The steel girders will be placed a rate of 2 girders per weekend shift.*
 10. The steel columns and steel girders will be painted at a rate of 1700 SF** per
 11. The Lally columns will be removed at a rate of 12 Lally columns per one weekend shift.*

APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

12. Removal of switches, connecting rail and setting up temp rail will be done at a production rate of 4 weekend shifts.*
13. Installation of each double crossover and signals will be done at a production rate of 4 weekend shifts.*
14. Signal testing, test train, and the cutover for each double crossover will be done at a rate of 4 weekend shifts.*
15. The tie-in to the Grand Central master tower and Rail Control Center of each double cross over will be done at a production rate of 2 weekend shifts.*

*One weekend shift is equal to three 8/hr shifts

**SF = Square Feet

***LBS = Pounds

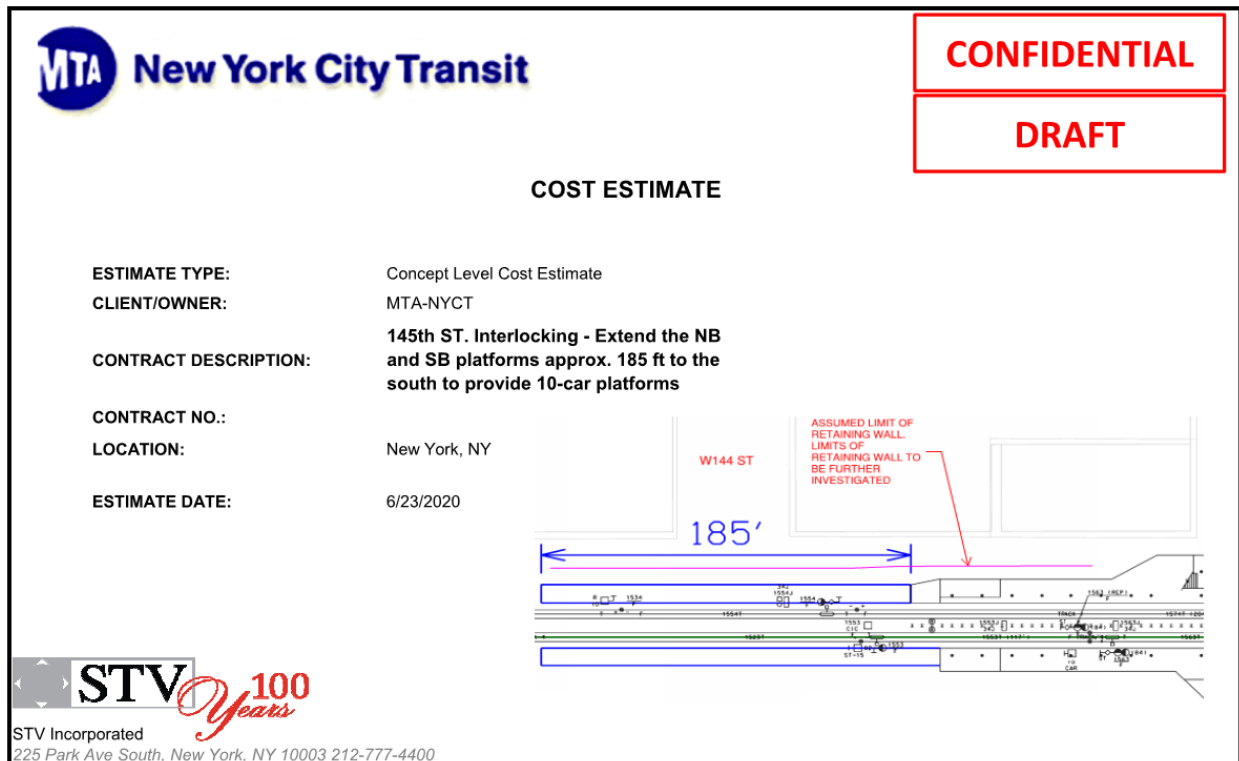
****CY = Cubic Yards

- f. The entire project is on the critical path because of the lack of concurrency in the construction sequencings due to the confined space. This increases the risk of not meeting the schedule because even a small delay to one activity will push out the project completion date by the amount of the delay. A time contingency should be added to the estimate for project delays.

APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

H.1.2 Expansion of 145 Street – Lenox Avenue Station

Table H.1-2. Budgetary Construction Cost Estimate, 145 Street – Lenox Avenue



APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

COST ESTIMATE SUMMARY			MTA-NYCT 145th St. Interlocking	
Contract No:				
Location:				
ESTIMATE SUMMARY				
Item No.	Description		Total Cost	
1	Extend the NB and SB platforms approx. 185 ft to the south to provide 10-car platforms		\$ 154,440,344	
2				
3				
4	Total Direct Cost		\$ 154,440,344	
5	General Conditions	10%	\$ 15,444,034	
6	Subtotal		\$ 169,884,378	
7	Overhead & Profit	15%	\$ 25,482,657	
8	Subtotal		\$ 195,367,035	
9	Bonds & Insurance	2%	\$ 3,907,341	
10	Subtotal		\$ 199,274,376	
11	Escalation - Excluded	0%	\$ -	
12	Subtotal		\$ 199,274,376	
13	Contingency	30%	\$ 59,782,313	
14	Total - Construction		\$ 259,056,688	
15	TA Support Labor	50%	\$ 129,528,344	
16	Total Estimated Cost		\$ 388,585,032	

APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

COST ESTIMATE		MTA-NYCT 145th St. Interlocking			
CONTRACT:					
LOCATION:					
Concept Level Cost Estimate					
ITEM NO.	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
1					
2	General Requirements	6%			\$5,594,820
3					
4	Demolition				
5	Demo existing street surface	2,000	CY	\$1,400.00	\$2,800,000
6	Support of excavation at street surface	5,000	SF	\$80.00	\$400,000
7	Excavation at street surface	5,000	CY	\$65.00	\$325,000
8	Temp. remove/relocate existing utilities	130	SHIFTS	\$20,300.00	\$2,639,000
9	Demo existing concrete roof	2,000	CY	\$1,400.00	\$2,800,000
10	Demo existing structural steel beams	50	PCS	\$47,500.00	\$2,375,000
11	Demo existing structural walls	800	CY	\$1,400.00	\$1,120,000
12	Demo existing structural steel columns	130	PCS	\$47,500.00	\$6,175,000
13	Demo existing structural base	700	CY	\$1,400.00	\$980,000
14	Excavation at exist retaining wall	800	CY	\$70.00	\$56,000
15	Demo existing retaining wall	400	CY	\$2,800.00	\$1,120,000
16					
17	Extend New Platforms				
18	Excavation for platform foundation - assume rock excavation	1,200	CY	\$2,800.00	\$3,360,000
19	Formwork for platform foundation	1,500	SF	\$70.00	\$105,000
20	Reinforcing for platform foundation	62,000	LBS	\$10.00	\$620,000
21	CIP platform foundation	500	CY	\$500.00	\$250,000
22	Formwork for platform walls	12,000	SF	\$70.00	\$840,000
23	Reinforcing for platform walls	28,000	LBS	\$10.00	\$280,000
24	CIP platform walls	200	CY	\$500.00	\$100,000
25	Formwork for platform	12,000	SF	\$70.00	\$840,000
26	Reinforcing for platform	56,000	LBS	\$10.00	\$560,000
27	CIP Platform	400	CY	\$500.00	\$200,000
28	Platform area finishes	15,000	SF	\$350.00	\$5,250,000
29					
30	Restoration				
31	Structural steel beams	892,000	LBS	\$20.00	\$17,840,000
32	Structural steel columns	387,000	LBS	\$20.00	\$7,740,000
33	Intumescent paint	64,000	SF	\$70.00	\$4,480,000
34					
35	Formwork for base slab	1,500	SF	\$70.00	\$105,000

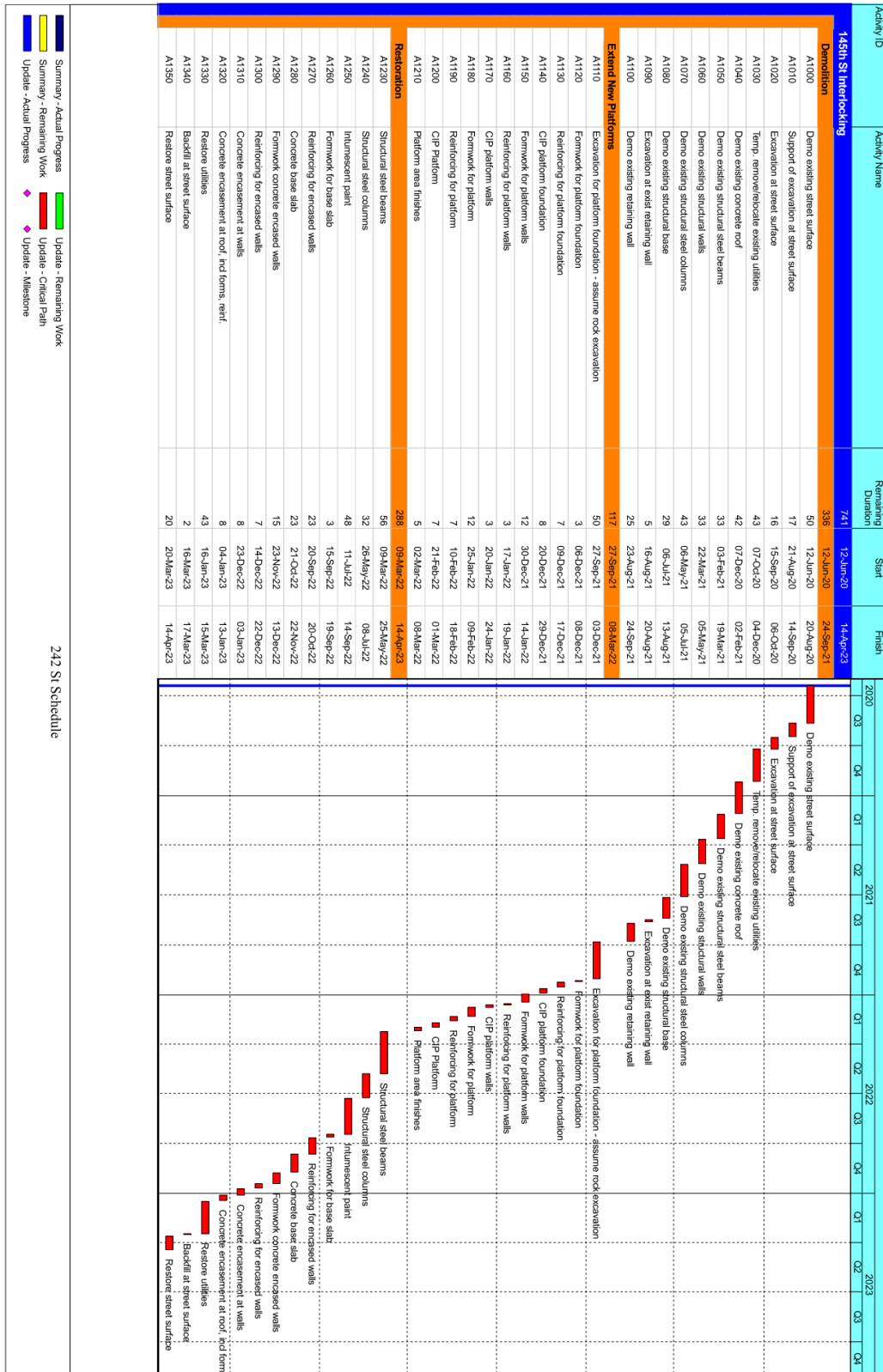
COST ESTIMATE			MTA-NYCT 145th St. Interlocking		
CONTRACT:					
LOCATION:					
Concept Level Cost Estimate					
ITEM NO.	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
36	Reinforcing for encased walls	388,000	LBS	\$10.00	\$3,880,000
37	Concrete base slab	3,000	CY	\$500.00	\$1,500,000
38	Formwork concrete encased walls	15,000	SF	\$65.00	\$975,000
39	Reinforcing for encased walls	124,000	LBS	\$10.00	\$1,240,000
40	Concrete encasement at walls	800	CY	\$1,600.00	\$1,280,000
41	Concrete encasement at roof, incl forms, reinf.	2,000	CY	\$3,500.00	\$7,000,000
42					
43	Restore utilities	130	SHIFTS	\$30,300.00	\$3,939,000
44	Backfill at street surface	5,000	CY	\$45.00	\$225,000
45	Restore street surface	26,000	SF	\$50.00	\$1,300,000
46					
47	Electrical - Power, Lighting, Signals, Comms Allowance	12,000	SF	\$500.00	\$6,000,000
48					
49	Flagging/Maintenance & Protection of Traffic - Allowance	260	SHIFTS	\$9,800.00	\$2,548,000
50					
51	Subtotal				\$98,841,820
52	Existing Logistics	25%			\$24,710,455
53	Subtotal				\$123,552,275
54	Phasing/Staging	25%			\$30,888,069
55	Total Direct Cost				\$154,440,344

APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

The foregoing budgetary estimate does not include “soft costs” or NYCT costs other than those indicated and excludes station finishes. This estimate is based on the following conceptual schedule and schedule assumptions.

APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

Figure H.1-2. Conceptual Construction Schedule, 145 Street – Lenox Avenue



APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

H.1.2.1 145 Street – Lenox Avenue Schedule Assumptions

DESCRIPTION	QTY	UNIT	PRODUCTION RATES	SHIFTS	CREWS	DURATION (DAYS)
General Requirements	0.12					
Demolition						
Demo existing street surface	2,000.00	CY	8	250	5	50
Support of excavation at street surface	5,000.00	SF	300	17	1	17
Excavation at street surface	5,000.00	CY	155	32	2	16
Temp. remove/relocate existing utilities	130.00	SHIFTS	0.5	260	6	43
Demo existing concrete roof	2,000.00	CY	8	250	6	42
Demo existing structural steel beams	50.00	PCS	1	100	3	33
Demo existing structural walls	800.00	CY	8	100	3	33
Demo existing structural steel columns	130.00	PCS	1	260	6	43
Demo existing tracks	-	TF				
Demo existing structural base	700.00	CY	8	88	3	29
Excavation at exist retaining wall	800.00	CY	155	5		
Demo existing retaining wall	400.00	CY	4	100	4	25
Extend New Platforms						
Excavation for platform slab - assume rock excavation	1,200.00	CY	4	300	6	50
Formwork for platform slab	1,500.00	SF	500	3	1	3
Reinforcing for platform slab	62,000.00	LBS	8,500	7	1	7
CIP platform slab	500.00	CY	65	8	1	8
Formwork for platform walls	12,000.00	SF	500	24	2	12
Reinforcing for platform walls	28,000.00	LBS	8,500	3	1	3
CIP platform walls	200.00	CY	65	3	1	3
Formwork for platform	12,000.00	SF	500	24	2	12
Reinforcing for platform	56,000.00	LBS	8,500	7	1	7
CIP Platform	400.00	CY	65	6	1	6
Platform Finishes	15,000.00	SF				
Restoration						
Structural steel beams	892,000.00	LBS	2,000	446	8	56
Structural steel columns	387,000.00	LBS	2,000	194	6	32
Intumescent paint	64,000.00	SF	167	384	8	48
Formwork for base slab	1,500.00	SF	500	3	1	3
Reinforcing for encased walls	388,000.00	LBS	8,500	46	2	23
Concrete base slab	3,000.00	CY	65	46	2	23

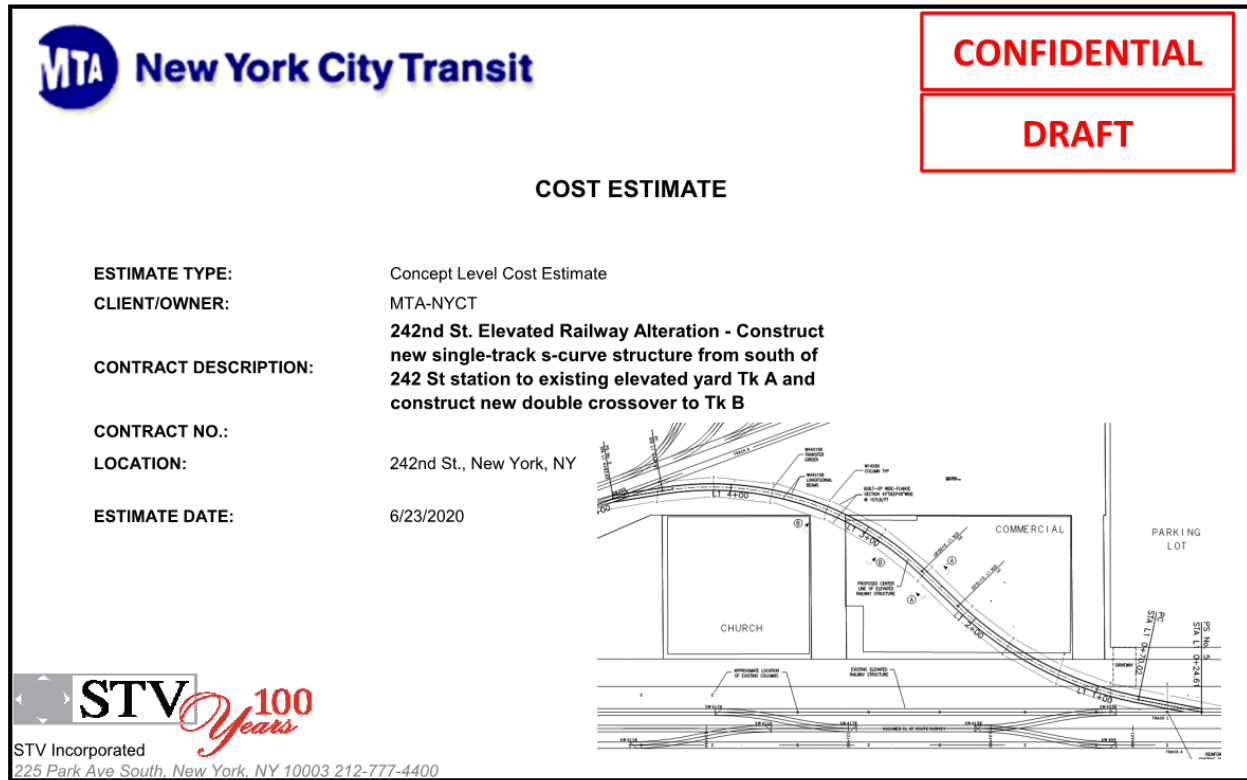
APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

DESCRIPTION	QTY	UNIT	PRODUCTION RATES	SHIFTS	CREWS	DURATION (DAYS)
Formwork concrete encased walls	15,000.00	SF	500	30	2	15
Reinforcing for encased walls	124,000.00	LBS	8,500	15	2	7
Concrete encasement at walls	800.00	CY	15	53	3	18
Concrete encasement at roof	2,000.00	CY				
Restore utilities	130.00	SHIFTS				
Backfill at street surface	5,000.00	CY	2,800	2	1	2
Restore street surface	26,000.00	SF	435	60	3	20

APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

H.1.3 New Lead to 240 Street Yard

Table H.1-3. Budgetary Construction Cost Estimate, New Lead to 240 Street Yard



APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

COST ESTIMATE SUMMARY			MTA-NYCT 242nd St. Elevated Railway Alteration	
Contract No:				
Location:				
ESTIMATE SUMMARY				
Item No.	Description		Total Cost	
1	Construct new single-track s-curve structure from south of 242 St station to existing elevated yard Tk A and construct new double crossover to Tk B		\$ 47,759,912	
2				
3				
4	Total Direct Cost		\$ 47,759,912	
5	General Conditions	10%	\$ 4,775,991	
6	Subtotal		\$ 52,535,904	
7	Overhead & Profit	15%	\$ 7,880,386	
8	Subtotal		\$ 60,416,289	
9	Bonds & Insurance	2%	\$ 1,208,326	
10	Subtotal		\$ 61,624,615	
11	Escalation (Not Included)	0%	\$ -	
12	Subtotal		\$ 61,624,615	
13	Contingency	30%	\$ 18,487,384	
14	Total - Construction		\$ 80,111,999	
15	TA Support Labor	50%	\$ 40,056,000	
16	Total Estimated Cost		\$ 120,167,999	

APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

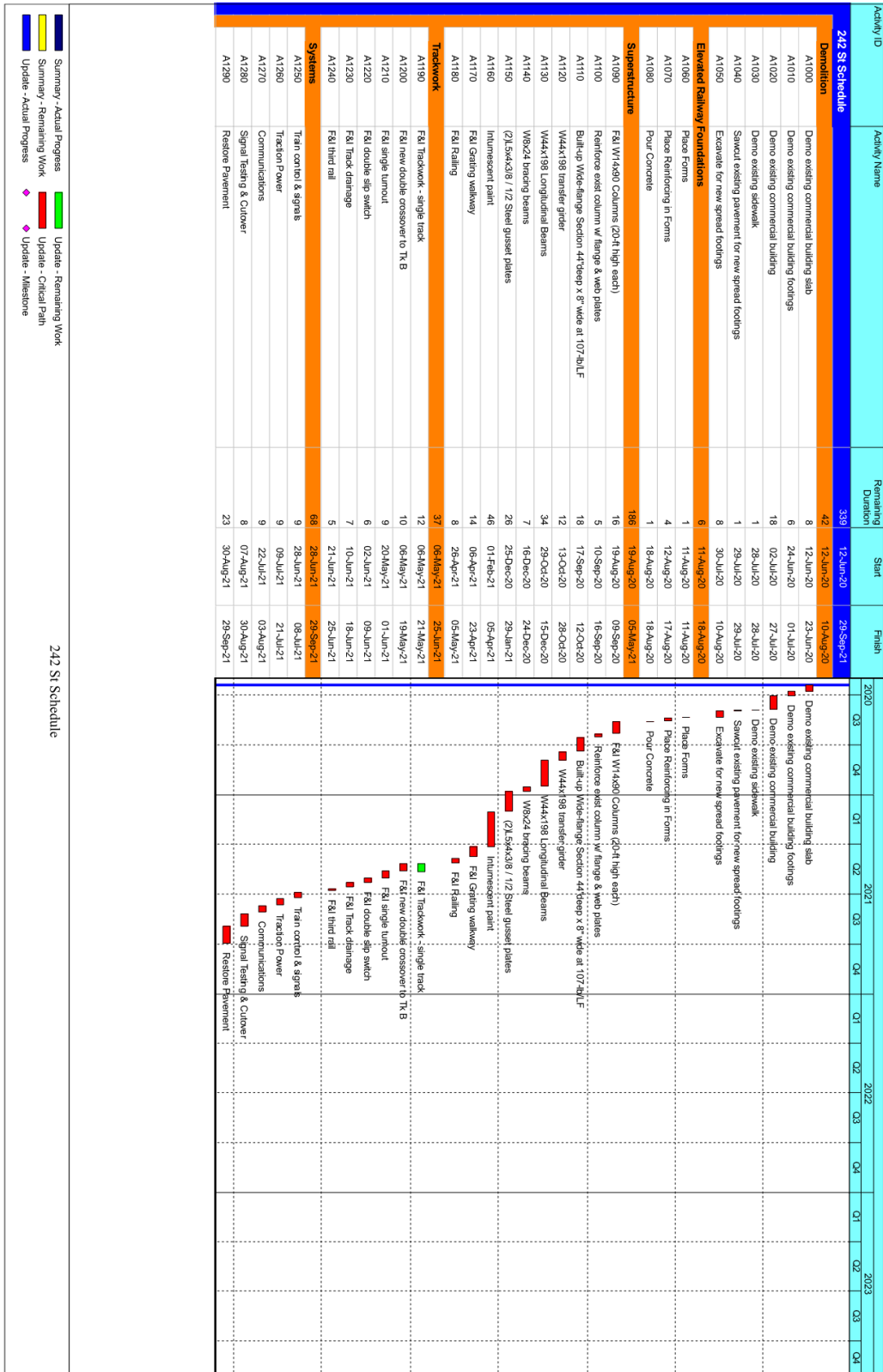
COST ESTIMATE			MTA-NYCT		
CONTRACT:			242nd St. Elevated Railway Alteration		
LOCATION:					
Concept Level Cost Estimate					
ITEM NO.	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
1	General Requirements	6%			\$1,730,170
2	Demolition				
3	Demo existing commercial building slab	29,882	SF	\$2.00	\$59,763
4	Demo existing commercial building footings	1,052	LF	\$40.00	\$42,090
5	Demo existing commercial building	896,448	CF	\$2.00	\$1,792,896
6	Demo existing sidewalk	243	SY	\$20.00	\$4,860
7	Sawcut existing pavement for new spread footings	920	LF	\$10.00	\$9,200
8	Excavate for new spread footings	426	CY	\$110.00	\$46,852
9	New Construction				
10	Elevated Railway Foundations				
11	F&I new column footings				
12	Forms	635	SF	\$40.00	\$25,392
13	Reinforcing	35,267	LBS	\$3.00	\$105,800
14	Concrete	141	CY	\$280.00	\$39,499
15	Superstructure				
16	F&I W14x90 Columns (20-ft high each)	47,610	LBS	\$20.00	\$952,200
17	Reinforce exist column w/ flange & web plates	2	LOC	\$62,000.00	\$124,000
18	Built-up Wide-flange Section 44"deep x 8" wide at 107-lb/LF	106,100	LBS	\$20.00	\$2,122,000
19	W44x198 transfer girder	37,100	LBS	\$20.00	\$742,000
20	W44x198 Longitudinal Beams	207,500	LBS	\$20.00	\$4,150,000
21	W8x24 bracing beams	20,400	LBS	\$20.00	\$408,000
22	(2)L5x4x3/8 / 1/2 Steel gusset plates	78,200	LBS	\$20.00	\$1,564,000
23	Intumescent paint	30,475	SF	\$60.00	\$1,828,500
24	F&I Grating walkway	4,244	SF	\$270.00	\$1,145,745
25	F&I Railing	1,000	LF	\$640.00	\$640,000
26	Trackwork				
27	F&I Trackwork - single track	530	TF	\$780.00	\$413,741
28	F&I new double crossover to Tk B	1	EA	\$1,378,000.00	\$1,378,000
29	F&I single turnout	1	EA	\$500,000.00	\$500,000
30	F&I double slip switch	1	EA	\$300,000.00	\$300,000
31	F&I Track drainage	530	LF	\$160.00	\$84,870
32	F&I third rail	530	LF	\$350.00	\$185,653
33	Systems				
34	Train control & signals	530	RF	\$880.00	\$466,785
35	Traction Power	530	RF	\$960.00	\$509,220
36	Communications	530	RF	\$560.00	\$297,045
37					
38	Signal Testing & Cutover	1	LS	\$770,000.00	\$770,000

COST ESTIMATE		MTA-NYCT			
CONTRACT:		242nd St. Elevated Railway Alteration			
LOCATION:					
Concept Level Cost Estimate					
ITEM NO.	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
39	Test trains - allowance for 8-weekend shifts	24	EA	\$20,000.00	\$480,000
40					
41	Restore pavement	32,100	SF	\$50.00	\$1,605,062
42					
43	Flagging/Maintenance & Protection of Traffic				
44	Flagging	260	SHIFTS	\$7,000.00	\$1,820,000
45	Maintenance and protection of traffic	260	SHIFTS	\$8,000.00	\$2,080,000
46					
47	Shift differential on labor - say allow 20%	1	LS	\$2,143,000.00	\$2,143,000
48	Subtotal				\$30,566,344
49	Existing Logistics	25%			\$7,641,586
50	Subtotal				\$38,207,930
51	Phasing/Staging	25%			\$9,551,982
52	Total Direct Cost				\$47,759,912

The foregoing budgetary estimate does not include "soft costs" or NYCT costs other than those indicated. This estimate is based on the following conceptual schedule and schedule assumptions.

APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

Figure H.1-3. Conceptual Construction Schedule, New Lead to 240 Street Yard



APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

H.1.3.1 New Lead to 240 Street Yard Schedule Assumptions

DESCRIPTION	QTY	UNIT	PRODUCTION RATES	SHIFTS (8 HR)	CREWS	DURATION (DAYS)
Demolition						
Demo existing commercial building slab	29,881.60	SF	3,600	8	1	8
Demo existing commercial building footings	1,052.25	LF	175	6	1	6
Demo existing commercial building	896,448.00	CF	16,750	54	3	18
Demo existing sidewalk	243.00	SY	240	1	1	1
Sawcut existing pavement for new spread footings	920.00	LF	800	1	1	1
Excavate for new spread footings	425.93	CY	55	8	1	8
New Construction						
Elevated Railway Foundations						
F&I new column footings						
Forms	634.80	SF	510	1	1	1
Reinforcing	35,266.67	LBS	9,600	4	1	4
Concrete	141.07	CY	100	1	1	1
Superstructure						
F&I W14x90 Columns (20-ft high each)	47,610.00	LBS	3,010	16	1	16
Reinforce exist column w/ flange & web plates	2.00	LOC		5	1	5
Built-up Wide-flange Section 44"deep x 8" wide at 107-lb/LF	106,100.00	LBS	3,010	35	2	18
W44x198 transfer girder	37,100.00	LBS	3,010	12	1	12
W44x198 Longitudinal Beams	207,500.00	LBS	3,010	69	2	34
W8x24 bracing beams	20,400.00	LBS	3,010	7	1	7
(2) L5x4x3/8 / 1/2 Steel gusset plates	78,200.00	LBS	3,010	26	1	26
Intumescent paint	30,475.00	SF	167	183	3	61
F&I Grating walkway	4,243.50	SF	310	14	1	14
F&I Railing	1,000.00	LF	120	8	1	8
Trackwork						
F&I Trackwork - single track	530.44	TF	44	12	1	12


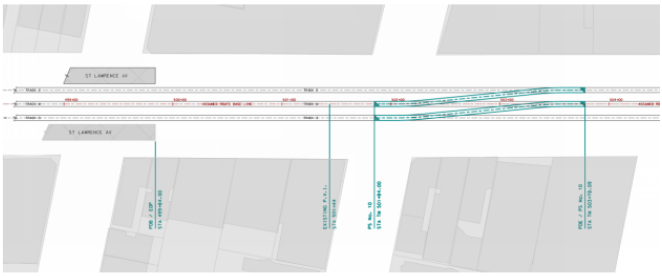

APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

DESCRIPTION	QTY	UNIT	PRODUCTION RATES	SHIFTS (8 HR)	CREWS	DURATION (DAYS)
F&I new double crossover between Tracks A and B	1.00	EA		10	1	10
F&I single turnout	1.00	EA		9	1	9
F&I double slip switch	1.00	EA		6	1	6
F&I Track drainage	530.44	LF	75	7	1	7
F&I third rail	530.44	LF	99	5	1	5
Systems						
Train control & signals	530.44	RF	20	26	1	26
Traction Power	530.44	RF	20	27	1	27
Communications	530.44	RF	30	18	1	18
Signal Testing & Cutover	1.00	LS		8	1	8
Test trains - allowance for 8-weekend shifts	24.00	EA				
Restore pavement	32,100.00	SF	685	47	2	

APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

H.1.4 New Crossovers South of Parkchester Station

Table H.1-4. Budgetary Construction Cost Estimate, Parkchester

		CONFIDENTIAL	
		DRAFT	
COST ESTIMATE			
ESTIMATE TYPE:	Concept Level Cost Estimate		
CLIENT/OWNER:	MTA-NYCT		
CONTRACT DESCRIPTION:	Add two #10 crossovers north of St. Lawrence Avenue station, Pelham Line, NYCT A-Division		
CONTRACT NO.:			
LOCATION:	St. Lawrence Ave., NY		
ESTIMATE DATE:	6/23/2020		
			
			
STV Incorporated 225 Park Ave South, New York, NY 10003 212-777-4400			

APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

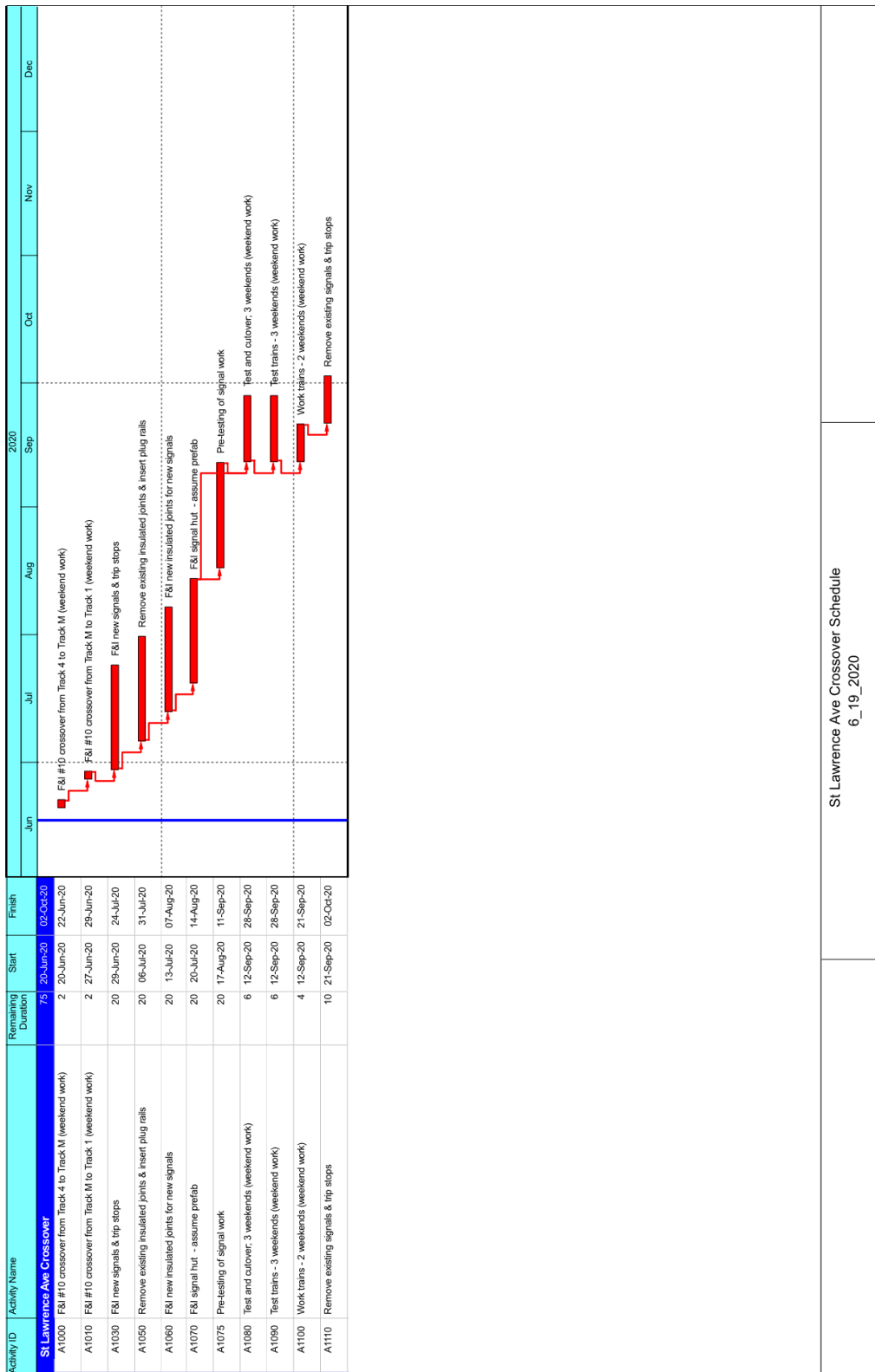
COST ESTIMATE SUMMARY			MTA-NYCT St. Lawrence Ave. Crossover	
Contract No:				
Location:				
ESTIMATE SUMMARY				
Item No.	Description		Total Cost	
1	Add two #10 crossovers north of St. Lawrence Avenue station, Pelham Line, NYCT A-Division		\$ 8,235,538	
2				
3				
4	Total Direct Cost		\$ 8,235,538	
5	General Conditions	12.0%	\$ 988,265	
6	Subtotal		\$ 9,223,802	
7	Overhead & Profit	15.0%	\$ 1,383,570	
8	Subtotal		\$ 10,607,372	
9	Bonds & Insurance	2.0%	\$ 212,147	
10	Subtotal		\$ 10,819,520	
11	Escalation (Excluded)	0.0%	\$ -	
12	Subtotal		\$ 10,819,520	
13	Contingency	30.0%	\$ 3,245,856	
14	Total - Construction		\$ 14,065,376	
15	TA Support Labor	40%	\$ 5,626,150	
16	Total Estimated Cost		\$ 19,691,526	

COST ESTIMATE		MTA-NYCT St. Lawrence Ave. Crossover			
CONTRACT:					
LOCATION:					
Concept Level Cost Estimate					
ITEM NO.	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
1	General Requirements	6%			\$298,344
2	F&I #10 crossover from Track 4 to Track M	1	EA	\$500,000.00	\$500,000
3	F&I #10 crossover from Track M to Track 1	1	EA	\$500,000.00	\$500,000
5	F&I new signals & trip stops - incl all signal components needed to put the crossovers into operation.	1	LS	\$2,150,000.00	\$2,150,000
7	Remove existing insulated joints & insert plug rails	6	LOC	\$2,000.00	\$12,000
8	F&I new insulated joints for new signals	6	LOC	\$5,000.00	\$30,000
9	F&I signal hut - Allowance	1	LS	\$500,000.00	\$500,000
6	Pre-testing of signal work	20	SHIFTS	\$10,700.00	\$214,000
10	Test and cutover; 3 weekends	1	LS	\$300,000.00	\$300,000
11	Test trains - 3 weekends allow	3	EA	\$20,000.00	\$60,000
12	Work trains - 2 weekends allow	2	EA	\$10,300.00	\$20,600
4	Remove existing signals & trip stops	6	LOC	\$21,300.00	\$127,800
13	Flagging - allow	90	SHIFTS	\$6,200.00	\$558,000
14	Subtotal				\$5,270,744
15	Existing Logistics	25%			\$1,317,686
16	Subtotal				\$6,588,430
17	Phasing/Staging	25%			\$1,647,108
18	Total Direct Cost				\$8,235,538

The foregoing budgetary estimate does not include “soft costs” or NYCT costs other than those indicated. This estimate is based on the following conceptual schedule and schedule assumptions.

APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

Figure H.1-4. Conceptual Construction Schedule, Parkchester



APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

H.1.4.1 Parkchester Schedule Assumptions

Special track work, testing and cutover are all assumed to be performed on weekends.

APPENDICES TO CAPACITY SENSITIVITY ANALYSIS

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IRT CAPACITY STUDY

1 2 3 4 5 6 S LINES

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Prepared for:



by:
STV
July 2020

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